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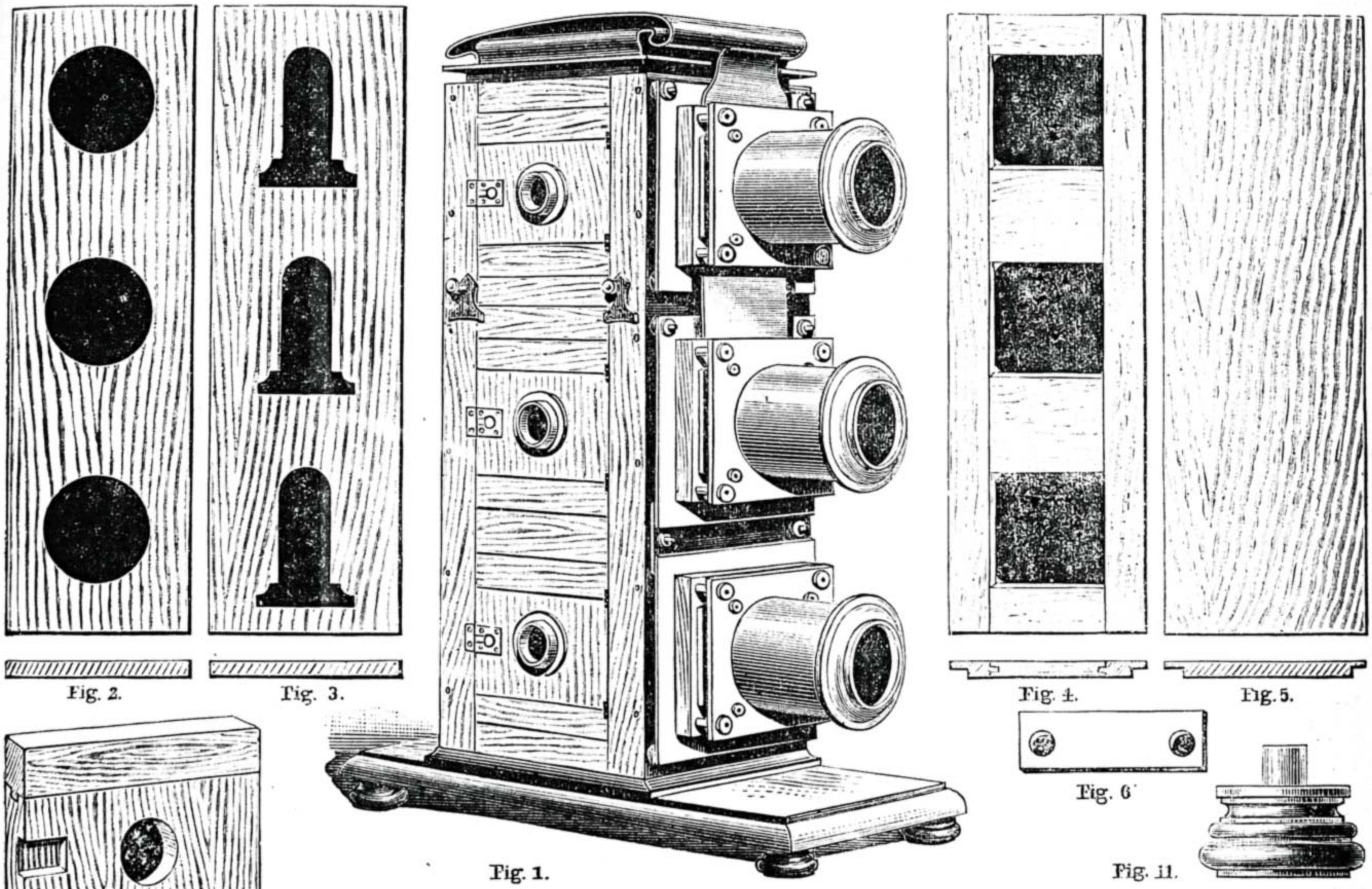

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 11.

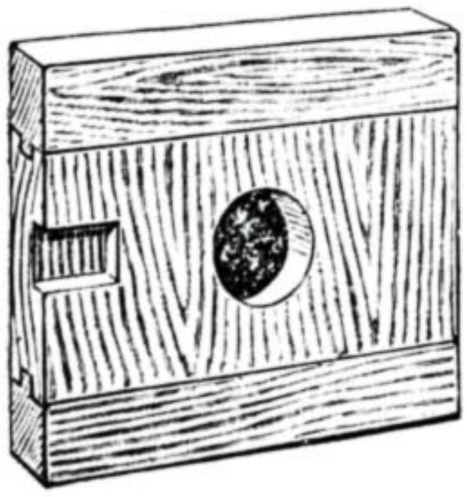

Fig. 7.

Fig. 9.

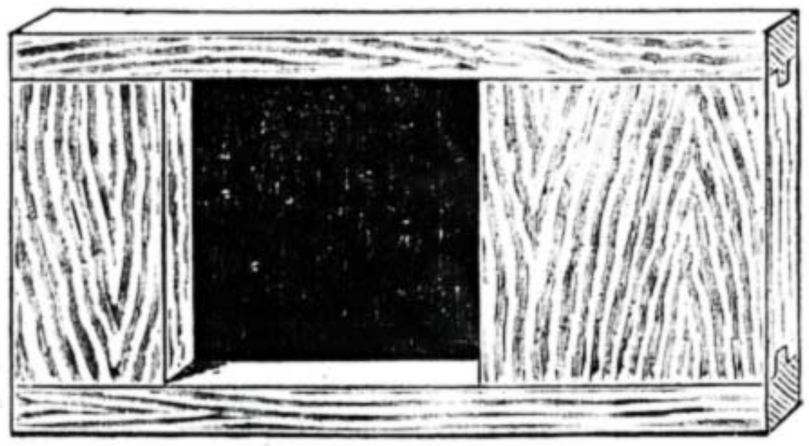

Fig. 8.

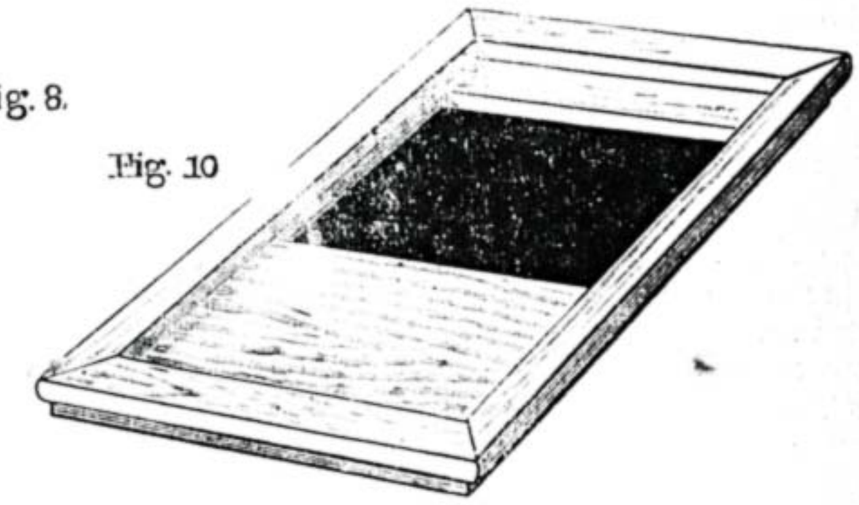

Fig. 10

Fig. 1.—Triunial Lantern complete. Figs. 2, 3, 4, 5.—Plans and Sections of Front, Back, and Side of Lantern Body. Fig. 6.—Brass Angle Plate for Door Openings. Fig. 7.—Plan of Door. Fig. 8.—Plan of Baseboard. Fig. 9.—Moulded Bead for Baseboard. Fig. 10.—Baseboard complete, showing Under Side. Fig. 11.—Turned Foot for Baseboard.

THE TRIUNIAL OPTICAL LANTERN: HOW TO MAKE IT.

BY CHARLES A. PARKER.

THE DISTINGUISHING FEATURES OF BIUNIAL AND TRIUNIAL LANTERNS—EFFECTS OBTAINED BY THE TRIUNIAL—THE CONSTRUCTION OF THE TRIUNIAL—ADVANTAGE OF A ROLLING CURTAIN DIAPHRAGM—SELECTION OF SUITABLE WOOD FOR BODY OF LANTERN—MARKING THE FRONT OF LANTERN BODY—CUTTING THE CONDENSER OPENINGS—PREPARATION OF BACK OF BODY—CUTTING OUT APERTURES—TONGUEING TOGETHER LEFT SIDE OF BODY—SCREWING TOGETHER LANTERN BODY—SEPARATION OF TOP LANTERN—PREPARATION AND HINGEING OF DOORS—BASE OF THE LANTERN.

THERE are few instruments of a scientific nature better calculated to entertain and instruct than the optical lantern, which has been steadily progressing in favour for some years past, and has now taken a high rank as a social entertainer and public instructor. It may be said that whereas other instruments, such as the microscope or telescope, appeal but to the educated eye, the effects obtained by means of the lantern are of such a nature that they can be understood and appreciated by a great number of people at the same moment. It is not my intention, however, to enter into a dissertation upon

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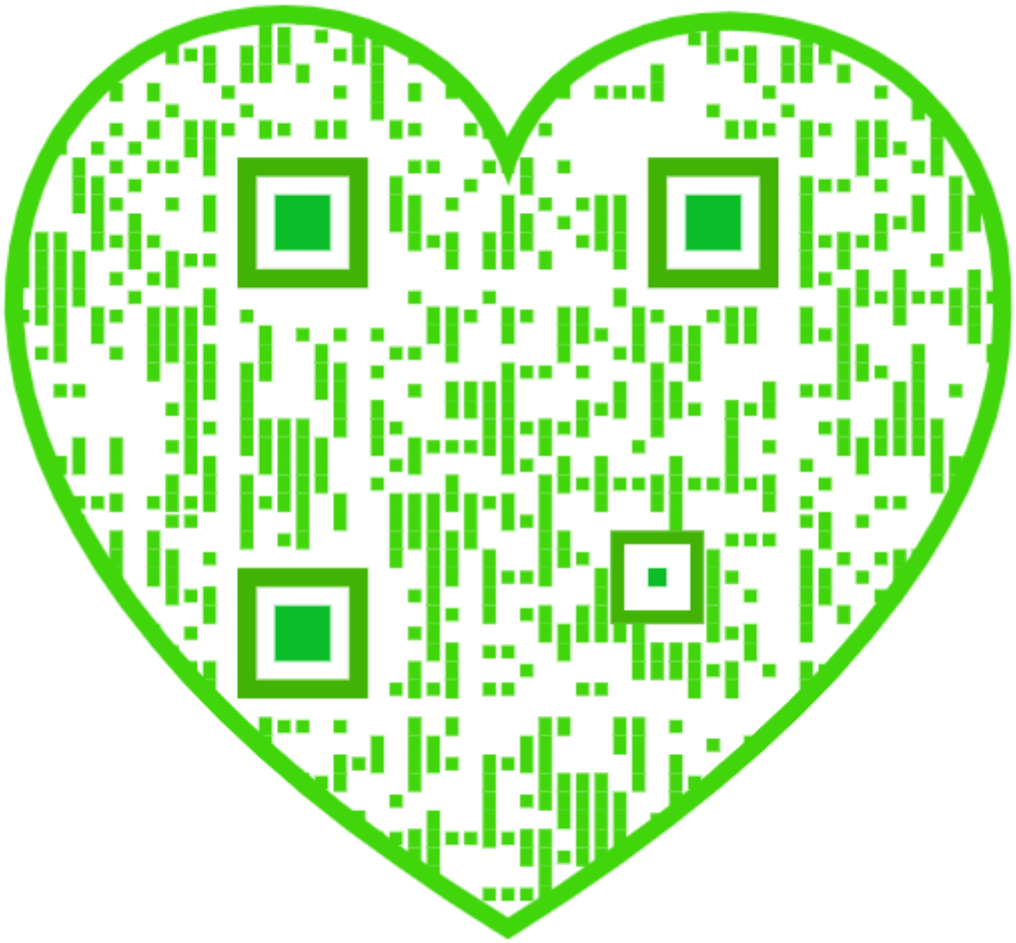

the history and applications of the optical lantern, but to describe the practical construction of a really serviceable instrument, suitable for home or exhibition purposes. And, in doing this, the various methods of lighting and preparation of the gases will be described, together with suggestions as to the best forms of oxyhydrogen jets, gas bags, etc.

Amongst the better class of limelight lanterns most generally used, the biunial is perhaps the most popular, the usual form of this instrument consisting of a vertical mahogany or metal body enclosing the two sources of light, together with the optical system; the two lanterns being divided by a metal floor or partition, upon which the trays carrying the jets may be slid. The triunial system, which is a still further improvement on the biunial, is an instrument in which three lanterns are placed one above the other, only differing from an ordinary biunial in the addition of the third lantern, which fits on to the top of the other two in place of a hood. The effects obtained by the use of a triple lantern are of such a character as it would be impossible to secure with an ordinary biunial; in fact, it will be generally found that the most successful exhibitors are those who employ a triple lantern; the value of being able to produce three coincident discs on the screen at the same time placing this form of lantern before all others for high-class effects.

It may not be out of place to point out a few of the advantages attending the use of a triple lantern. This instrument, which is illustrated in Fig. 1, consists essentially of three lanterns placed one above the other, as before stated; and it is generally constructed so that the top lantern can be removed and fitted on to a separate baseboard, if required to be used by itself as a single lantern; the lower portion of the instrument with the addition of an extra top will then form an ordinary twin or biunial lantern. By an intelligent use of the triple, various complex effects may be shown which could not be manipulated in an ordinary biunial, as the following examples will serve to show; taking, for instance, the well-known set illustrating the soldier's dream with its five effects. The principal slide of the series depicts the soldier asleep by a camp fire on the battle-field, and presently his dream of a happy home is made to appear in the smoke arising from the fire by placing the slide on which it is painted in the second lantern; this in turn being dissolved into another slide representing the departure for war, which afterwards gives place to scenes on the battle-field, and ultimate victory; the first picture of the soldier asleep remaining on the screen all the time. The first and second effects are placed in the second and third lanterns, and alternately dissolved without disturbing the sleeping soldier.

The set of eight slides depicting the emigrant ship forms another fine series of effective slides for use with a triple lantern. The foundation slide represents a ship toiling over the waves in a calm sea, which is shortly changed to a stormy one with an angry sky and flashes of lightning striking the masts of the vessel, these slides giving place to others showing the ship on fire, and the rescue of the passengers and crew. Effects such as these, which are by no means the only kind that can be exhibited, always meet with the approval of an audience; and although the manufacture of a triple will involve an extra expenditure of time and trouble, it will not be regretted, as this is the exhibition instrument *par excellence*. It will be seen from the foregoing that the reader requiring a single lantern may follow the measurements and constructive details given for the top lantern; and those who desire the more convenient biunial will find their want supplied by the twin lantern without the top one; but the operator wishing to give exhibitions of the highest class should employ the triple lantern as illustrated.

It will, perhaps, clear the way for the more minute details which will soon occupy our attention, if a careful description is first given of the triple lantern about to be described, which is illustrated in Fig. 1. This consists of a vertical wooden body constructed of well-seasoned material and provided with a protective sheet-iron lining, which is kept entirely independent of the wood, with a clear air space all round to ensure perfect ventilation. The body of the instrument is provided with nine openings, which are disposed in the following manner: three each at the back and front to receive the jets, trays, and the condensers; and three on one side fitted with small doors, which are framed together so that the heat cannot cause the wood to warp, each of these doors being furnished with a darkly coloured glass centre, through which the operator can watch the jet during exhibitions without straining the eyes, or requiring to open the door. The front stage plates and slide stages, which should be made of brass, are fitted with regulating screws and milled nuts to enable the entire front, with condensers, stages, and objectives, to be lowered or tilted to any desired angle, in order that the discs from the top and bottom lanterns may be made to exactly coincide when thrown upon the screen. As the condensers are attached to a collar fitted to the stage plate, they consequently move with the objective, and thus ensure the optical axis of one agreeing with the other. The slide stages are entirely open both at the top and sides, and a light tight plate, provided with a spring, is so arranged as to keep any form of slide or tank securely in position. It will be found a great advantage having the stages open all round, as it permits the slides to be inserted from the top or sides, the latter course being absolutely necessary when a tank is employed for the performance of chemical experiments. The lantern is divided into three separate chambers by means of three metal partitions, which form the supports for the jet trays to slide along, each of these chambers being, in fact, a separate lantern, having its own jet, condenser, stage plate, slide stages, and objective. The top lantern, which is removable, is retained in position by four brass straps and milled nuts which screw into the woodwork on either side, and secure it to the body of the instrument. The two lower lanterns are of course attached to a suitably moulded plinth, but an extra plinth can be made for the top lantern, supposing that the operator intends using it occasionally as a single lantern. A rolling curtain effect, which is now considered to be an almost indispensable fitting for all high-class lanterns, forms a very agreeable change from the ordinary dissolving arrangement; and as it is of simple construction, its addition to the lantern under description will not be found very difficult. A long thin strip of brass, having a rectangular aperture at its upper end, is so arranged as to slide up and down between the condensers and the slides, from one lantern to the other, this action causing the light from one lantern to be obscured while the other is exposed. In use, a slide representing an arrangement of curtains similar to the act drop of a theatre is placed in the slide stage of the second lantern, and the first slide of the lecture set or series of views to be exhibited is put in the stage of the upper lantern with the curtain diaphragm drawn up so as to obscure the slide, and only show the painted curtain on the screen, both lanterns meanwhile being fully lighted. If the diaphragm is now steadily pushed downwards, it will shut off the light from the second lantern, and at the same time expose the view in the upper one, making it appear as though the curtain were being rolled up.

Having obtained a good general idea of the materials, construction, and relation of the various parts of the instrument, it will now be advisable to enter into the manipulatory details involved in constructing the same, and in doing this it shall be our endeavour to follow some regular plan, or at all events to treat the various parts in the sequence in which it would appear most convenient to handle them. The most suitable timber to employ for the outer wooden carcase of the lantern will be a piece of sound dry bay mahogany ¾ in. thick, preferably a piece that has been previously worked up—for instance, the panel of a disused sideboard or wardrobe; or, better still, a leaf out of an old dining-table. If the wood is obtained from a timber yard it should be kept in a warm, dry atmosphere for a few days prior to using, in order to entirely free it from all traces of moisture. The necessity for employing thoroughly well-seasoned wood cannot be too strongly impressed upon the reader, as the lantern, unlike a great many optical instruments, has to bear a considerable amount of wear and tear; and unless it is constructed of properly seasoned material the great heat will certainly cause it to warp and shrink.

Assuming that a suitable board, or a couple of boards for a matter of that, have been selected upon which to commence operations, it will be necessary in the first place to provide each side with a perfectly smooth and level surface by means of careful planing, after which three of the four sides of the body are drawn out upon the wood by the aid of a marking gauge. For convenience in working, it will be seen that the body is made in the first instance the full height of the triple, but after it has been put together the top lantern may be separated from the others by sawing the body in two. The first proceeding will be to make the front, which is shown in Fig. 2; this is formed of a single piece of wood sawn off to measure 26½ in. by 8 in. when finished, care being taken in sawing not to encroach upon the gauge line, but to leave this plainly visible on the wood after it has been sawn; it will then allow the edges to be shot in order to bring it to the required size. Thus prepared, the wood must be provided with three 4½ in. circular apertures placed at equal distances apart, as will be seen in the illustration. With a pair of compasses first strike out the lower circle, the axis of which is situated at exactly 4½ in. from the lower end of the wood, and 9 in. above this mark the axis of the second circle, with another 9 in. between the axis of this and the axis of the third or top circle. These circles may now be cut by means of a keyhole saw or fret saw, which is inserted through a hole bored in the wood by a centre bit, the sawn edges being afterwards smoothed with a

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spokeshave, care being taken to keep the circle true. In sawing these apertures it is important to try and work the saw in a uniform direction in order that the sawn edges may be square with the face of the wood, as an irregular opening would impart a very slovenly appearance to the work. They may, of course, be sawn with a greater degree of accuracy if the reader possesses or has access to a fair sized fret-sawing machine. It may be worthy of mention that at Mr. Fletcher's steam saw works, 161, City Road, London, E.C., wood of this kind will be sawn accurately to pattern by means of a steam fret saw for a few pence.

The next thing to be considered is the preparation of the back of the lantern with its three apertures for the reception of the jets, as shown in Fig. 3. Select a good sound piece of wood, and after having sawn it to a suitable size shoot the edges with a plane until it measures 26½ in. by 8 in. The black portions of Fig. 3 represent the wood which must now be cut away to form the jet apertures, each of which should be 6 in. in height and 4 in. in width at the lower part, tapering to 2 in. at the top, the lower aperture being planted at an inch from the bottom of the wood, with a 3 in. space between each one. The cutting may be easily managed by the aid of a stock and bit, and a keyhole saw, or by a fret saw as above advised. First mark the extent of the opening, then bore a hole by means of the stock and bit at each of the lower corners. These holes will render the introduction of the saw and the subsequent removal of the central portion a very simple and easy matter. When the apertures have been cut, the sawn edges will require to be smoothed with a spokeshave and afterwards rubbed down smooth by means of a piece of glass-paper, which should be wrapped round a piece of cork or wood in order to prevent the edges of the apertures from becoming rounded.

The front and back being finished so far, it behoves us to turn our attention to the preparation of the two sides which are illustrated in Figs. 4 and 5, each of these measuring when finished 26½ in. by 8½ in. Fig. 4, which is the left side of the body, is formed of six pieces of wood tongued together in such a manner as to leave three square openings for the reception of the doors. The longitudinal side clamps are a couple of strips of wood 26½ in. by 2 in., each of these having a ¼ in. projecting tongue formed along one edge for the entire length by means of a tongueing plane for ¾ in. wood. A 12 in. by 5 in. piece of wood will next be required for the central clamps. This should be furnished with a ¼ in. groove run across the grain along each of the long sides, into which the tongues of the side clamps may be fitted. When this groove has been run the wood may be ripped into four strips, two of them being 4 in. wide, with the grooves at each end, and the others half this width. After the edges have all been carefully shot until quite true and square with the face, the six pieces may be fitted together to form the side, as shown in Fig. 4, by applying some hot glue to the tongues and grooves, and clamping the whole together; the projecting tongue within the squares to be occupied by the doors being afterwards pared away neatly by means of a sharp chisel.

The right side of the body, shown in Fig. 5, will require no further preparation after squaring up beyond a ¾ in. rebate run to half the thickness of the wood along each of the long sides, a similar rebate being run longitudinally along each edge of the left side of the body, as will be understood by reference to the sections of Figs. 4 and 5. Thus prepared the body will be ready for screwing together; but before doing this it will be found advisable to affix a couple of small brass plates, similar to Fig. 6, to the top and bottom angles of the door openings, to form stops for the latter to shut against. A couple of strips cut off the leaves of an old brass butt hinge will answer capitally, as the holes for affixing to the woodwork are ready drilled. As soon as this has been done, the four sides forming the body of the lantern may be screwed together with 1 in. brass screws, the holes for which should be countersunk by means of a rose bit. A square should be occasionally applied to the inside of the body in order that it may be put together quite true; and it must be remembered that the scores of the screws always run in the direction of the grain of the wood.

The next proceeding will be to saw the body into two portions, if it has been decided to occasionally employ the top one as a single lantern. Run a line all round the body, 9 in. from and exactly parallel with the top edge; then by means of a fine tenon saw very carefully cut through one side at a time, being particular to saw it to the line, after which the smoothing plane should be run round the sawn edges a few times in order to remove their roughness.

The carcase is now ready for the doors, and before cleaning up the wood it will be advisable to make and fit these. Each door is composed of three pieces of wood tongued and clamped together to form a door 5 in. square, the central portion measuring 5 in. by 3 in., and the top and bottom rails 1 in. by 5 in. The latter should be 1¼ in. wide at the outset, in order to allow for a ¼ in. tongue to be run along the full length of each rail, the centre clamp being provided with a corresponding groove run along both the 5 in. sides, into which the tongue may be fitted, the whole being glued and clamped together to form the door shown in Fig. 7. Each door should be furnished with a small sight hole about an inch in diameter, bored through the wood by means of a suitable brace and bit, and when the lantern is finished a small brass eyepiece, fitted with a piece of coloured glass, is to be screwed on to the outside of each hole. These eyepieces can be obtained from any manufacturing optician at about one shilling each.

The doors are now ready for hingeing with ¾ in. or 1 in. brass butt hinges, which are sunk into the door stiles at about an inch from the top and bottom, with the round or pin edge on the outside. The door should first be hung with only one screw to each hinge in order to facilitate any alterations, as it will be necessary to see that they hang without springing open, or rubbing against any part.

Nothing remains to be done but to call attention to the base to which the body is affixed. The top of this is formed of four pieces of ¾ in. wood tongued together as shown in Fig. 8. The longitudinal outside clamps measuring 18 in. by 1¼ in. are furnished with ¼ in. tongues that fit into corresponding grooves cut in the middle clamps, which measure 7¼ in. by 7 in. and 7¼ in. by 3¾ in. respectively, the whole being clamped together in the usual manner with hot glue to form a board measuring 18 in. by 9¾ in. When the glue has set, the outer edges should be moulded by means of a bead plane, in order to improve its appearance; and a moulded bead of mahogany, similar to Fig. 9, should be sawn into two 11½ in. and a couple of 19½ in. lengths, which are mitred at each end and glued and screwed round the under edge of the base, in the position shown in Fig. 10. The baseboard is affixed to the wooden body by means of screws driven through from the under side of the baseboard; a narrow moulded bead being afterwards glued round the junction of the lantern body with the baseboard.

The ball feet with which the four corners of the base are provided are about 2 in. in diameter, and should be furnished with tenons turned on them to fit into holes bored for their reception at the four corners of the base by means of a suitable brace and bit. Fig. 11 is a good example for one of these turned feet. Finally the whole of the woodwork should be surfaced until every speck of roughness has disappeared, after which it may be carefully gone over with the finest glass-paper, when it will be ready for polishing after the inner metal lining has been fitted.

The next paper on this subject will be devoted to a description of the metal lining. In the meantime, however, our readers will find abundant occupation in constructing the wooden carcase herein described.

HOW TO PACK FRAIL ARTICLES FOR TRANSIT.

BY J. WHITFIELD HARLAND.

As secretary to the forthcoming "Work" Exhibition, 1890-91, I find from the correspondence that many readers of WORK who have lavished time and care in making articles only too well worth exhibiting are afraid to trust them to carriers, lest they be damaged in transit. To such and to other readers I think it worth while to give a few hints as to the packing of frail articles, and "how to do it," so that carriers cannot shirk any responsibility; and I hope this will be the means of persuading everyone who is wishful to enter the arena with the most valuable pieces of work they have done not to be deterred by any idle fear of consequences, should an accident happen.

Again, the work of packing is quite as, if not more, important a subject for an article as that of making anything. All labour, when reduced to first principles, can only be defined as moving particles or atoms of matter. Man cannot create matter, but he can alter form, position, and arrangement thereof. He cannot destroy matter itself, but he can destroy its relative combination with itself, either in the shape of one body composed of matter, or an aggregate composed of several different bodies; and can construct other combinations either of one or more bodies by moving their atoms into different positions. Man cannot annihilate, but he can and does *waste* material matter. Burning, for instance, does not destroy matter; it simply converts the form and substance it takes into a perhaps less useful form.

In attacking the subject of packing safely for transit, the careful work of hundreds of hours' labour, let me at once point out that in point of constructive strength a good strong back is the first consideration. Even in a fight with desperadoes, two or three to one, the odds are that, if one can only get one's back to the wall, they are greatly equalised. One then faces one's foes and one's difficulties, and can be certain that no attack from behind can succeed.

Hence readers will follow me when I say

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that for protecting goods from damage, the first thing is to provide a strong backboard, that will neither give nor take, as a basis, and to screw the article firmly to it, as to a wall. Then, to take further precaution, build up sides to protect its edges, and a front to prevent facial damage. On this principle depends "good work" in packing. Mere boxing up anyhow, without thought or design, is no use at all; there must be a governing principle in all a man does, or his efforts are no more likely to produce success than a monkey's; perhaps not so likely, since monkeys obey instincts which men have not, as, being a superior being, he has furnished to him, instead of instinct, what monkeys have not—reasoning powers and the analogies inherent in thought and the knowledge resulting from experience. Without further preamble, the likely to occur in transit. For these strains as above mentioned, construct a strong backboard, rather larger than the object to be packed, leaving room for sides, top, and bottom that shall not touch the object. Let your only contact be with the back, to which firmly screw the back of the object, or the top of your table or washstand, etc. This back should be made of strong stuff jointed together, and further strengthened by battens on its outer side. If the article to be packed weighs 1 cwt. and upwards, 1 in. stuff should be used; for lighter things, ¾ in. will be sufficiently stiff; but for 3 to 4 cwt., nothing under 1½ in. stuff should be thought of for the back; and then a batten every two feet, 4 in. wide, and same thickness as the back itself, should be nailed on. The sides may be half the thickness of the back; they should be dovetailed (but may be Figs. 5 and 6, by buttoning the back down to the backboard, and then, to prevent the buttons turning, putting a nail or screw through the extreme end of the buttons into the backboard, and thus securing them from any possibility of turning.

There is also another danger from what I can best describe as "concussion" in packing for transit. Even a firm back having the object, whatsoever it be, firmly screwed tightly to it, is apt to undergo unforeseen strains in shunting, marshalling trains, and other processes; to obviate all danger from which I suggest pads of vulcanised india-rubber, or "washers" of rubber (which can be purchased at any ironmonger's), between the article and the backboard to which it is screwed: that, being resilient, may take the shock of any such strain.

I must now just glance at a very

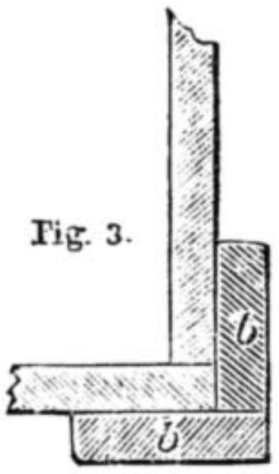

Fig. 3.

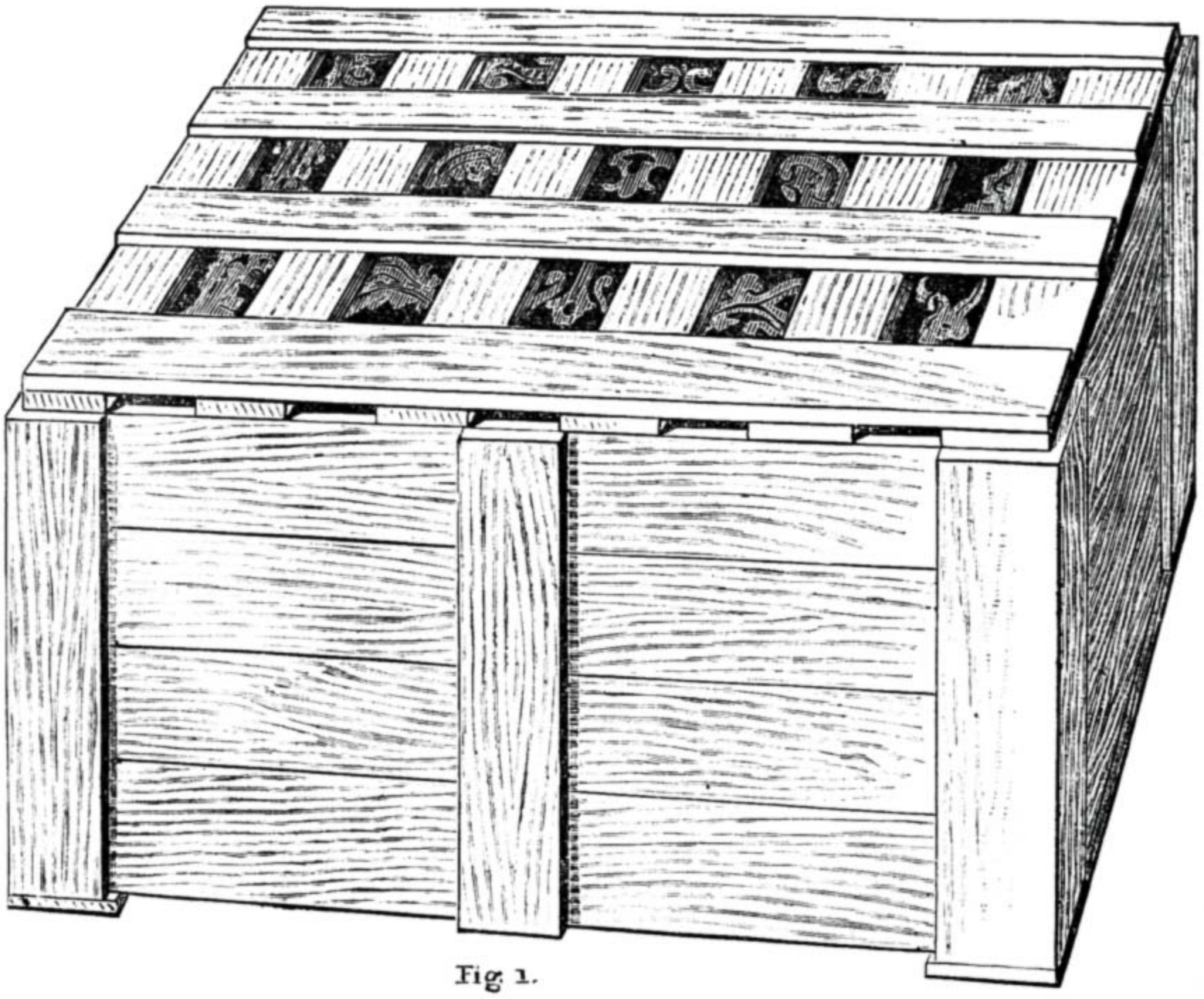
Fig. 1.

Fig. 4.

Fig. 5.

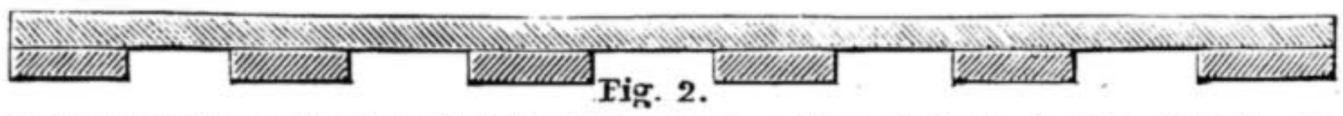
Fig. 2.

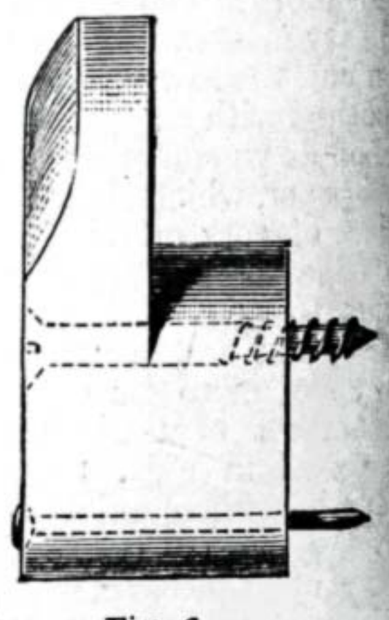
Fig. 6.

Fig. 1.—Perspective View of Packing Case with Open Lattice Lid, showing Carved Work inside. Fig. 2.—Longitudinal Section of Lid. Fig. 3.—Section through Corner, showing Overlapping of Battens *b*, *b*. Fig. 4.—Section through Backboard, showing Battens on End and below Backboard. Figs. 5, 6.—Plan and Side View of Batten for fixing Articles to Backboard when screwing would spoil them.

safety during transit of any article depends entirely upon supporting the back, or the top, in case of tables, by a strong foundation; and then preventing all possibility of side strains, which might otherwise break the structure ordained to stand ordinary strains, though incapable of resisting strains that might incidentally occur in transit: which, be it remembered, are not to be foreseen and provided for in the progress of construction, and must therefore be relegated to the art of packing for transit, which is, after all, no part of the purpose for which their primary construction was ever undertaken. A man designs a piece of workmanship to be "a thing of beauty and a joy for ever" in its own sphere and place, adapting the strength of its construction for the resistance of such strains as are likely under ordinary circumstances to come into play; but if he finds it has to travel, he naturally has to supplement his provision for ordinary strains by measures for counteracting extraordinary strains: viz., those merely nailed together), as they derive support from the back, and, as will be presently shown, from the front or lid.

These sides, which include top and bottom of course, should be of a width to allow the front or lid to fit on without any contact at all with the front or face of the article to be packed—that is, about 1 in. wider than the extreme depth of it. In the case of a chiffonnier, cabinet, piano, organ, bracket, frame (glazed or otherwise), sideboard, etc., and similar articles, the sides may consist of simple boards; but in the case of tables, washstands, etc., and other like articles, the backboard being the top of such when packed, the sides should be strengthened, according to the width of them, by either battens or cross-battens, to stiffen them in case of rough usage. (See sections of corners, Figs. 3 and 4.)

Here let me allude to cases where it would spoil the exhibit to put screws into the back. I would suggest the means of getting over this difficulty, as shown in important consideration before explaining how to make the lid or front of the case.

Railway companies and forwarding agents are what the law terms "common carriers" in respect of most articles they undertake to convey, and have a uniform tariff of charges for conveyance of each class of goods. They are liable for all breakage or damage, unless either the sender chooses by paying less freight to contract himself out of this benefit by sending at "owner's risk," or in the case of goods of higher value than the law permits him to recover from the carrier under the various Acts of Parliament, being sent without being insured. In order to recover loss or damage, however, it must be clearly proved that such damage is not in any way due or attributable to the act of sender, either by reason of improper or careless packing, or not correctly declaring contents or value of enclosures. Of course, if a case be nailed up, the various processes of loading, transhipping, and unloading by the Company's servants, even

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when "Glass, with Care," "Fragile," "This side up," etc., are written on the lid, do not command any extra care from them; and the onus of proving that the packing has been properly done falls on the sender. But if the lid consists of open lattice-work, strong enough to protect the contents from breakage, yet permitting the interior to be fully seen by all through whose hands it passes, any accident would be at once perceived. The Company's servant that receives and signs for such a case and package cannot deny that it was properly packed, or that it was injured when he got it. When it is transferred to another Company or a carter for delivery, it will be noticed at once whether it is still in good condition, and the consignee can also see if it is injured at all, and if it be, he can refuse to accept delivery.

This may be compared to the two means of securing shops, banks, etc., from burglars' attacks—the old style of putting up shutters, strongly made, lined with sheet-iron, barred and double-barred and barricaded from within, which burglars dearly like to see; or the modern style of open iron railings to protect the glass, and leaving the whole interior visible from the street, and burning a jet of gas all night, which practically defeats the burglar.

I therefore advise the lids of all packing-cases (see Fig. 1) for frail goods to be made in strips, nailed on width-wise pretty close together; and nailing to and over them, lengthwise, other strips or battens, also leaving spaces between them, like hatchways. Having cut the stuff to the right lengths, I should nail the pieces together first, and clinch the nails (see Section, Fig. 2) before nailing them to the sides and ends; and short pieces of hoop-iron should, if the package is heavy, be nailed to the back, bent round, nailed to the sides, and then turned over the ends of the battens of the lid and nailed to them—say two, three, or four, according to circumstances—at each side and end of the case. This plan affords sufficient protection for the article inside, and yet allows of its being clearly seen at every change of position during its transit; and thus any damage would be detected at once, the blame thrown on the right shoulders, and any claim for compensation would hold good; as neither the defence of bad packing could be pleaded, nor that of improper declaration of contents or value. I have been led into making these remarks by the correspondence arising with intending exhibitors, who write that they are afraid to trust their exhibits to "the tender mercies of railway carriers." I conclude by suggesting that such exhibitors should pack their exhibits as above shown, and obtain the receiver's signature to a written form, thus worded:—

Received from.....
one package containing.....*visible from front*, of the value of £ s. d. *Insured* (or if uninsured, add the words "*not at owner's risk*"). Per.....
(here insert carrier's name or Company's name), (1) Goods Train, (2) Passenger Train, or (3) Van (if no railway transit is necessary), in good condition. Consigned to.....
.....
Date..... Signature.....

Not only would this receipt place the carrier out of court in any proceedings that might be taken for compensation, but would probably prevent any necessity for proceedings, as the claim would be allowed and settled without that trouble.

In conclusion, I think I can promise that the proprietors of WORK would, in case any article was injured in transit, instruct the Jurors to consider it as if it had arrived in a perfect state, whenever time happened to be too short to repair it in, leaving the exhibitor entirely free to claim from the carrier the cost of the damage; and, as secretary, I shall instantly advise the exhibitor, *by next post*, of the receipt of every exhibit he sends, and state whether safe or damaged.

THE GASSNER PATENT DRY BATTERY.

BY GEORGE EDWINSON BONNEY.

IT is not many years since we were content with an ordinary system of house-bells, with their wires, cranks, and pulls. Electric bells were then unknown. They are a modern innovation, and were thought most wonderful things when first introduced. The novelty has now worn off, and their use has become quite common since M. Leclanchè invented the battery which bears his name. This useful battery has quite revolutionised the electric bell trade, on account of its known reliability, cleanliness in working, and cheapness. But we live in an age of

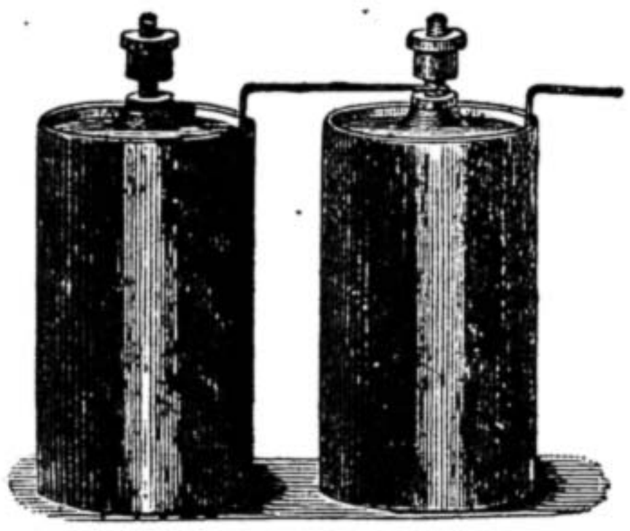

Fig. 1.—Gassner Dry Battery: Round Cell.

progress, and move on from one stage to another at such a rate that the excellent things of to-day may be condemned as antiquated curiosities to-morrow. Those who sighed for a cleanly working battery, giving little trouble, to use with electric bells, and rejoiced in the invention of M. Leclanchè, now find his excellent cell messy, troublesome, and lacking in portability. The ammonium salts creep up and destroy the wires and terminals; the solution evaporates and leaves the elements dry; or the cells get broken or capsized, and the solution gets spilled. The cells must therefore be kept in a cool place, and are not at all admissible where the solution is likely to be slopped or jerked out by jolting motion.

These little inconveniences led electricians to turn their attention in the direction of a dry battery, or one in which there should be no danger of spilling the solution. This desired condition has been obtained by various devices, such as the employment of some porous absorbent for the liquid; and in this way, sawdust, paper, felt, peat, moss, and other porous and bibulous substances too numerous to mention, have been employed. All have failed, from some cause or causes unthought of at first by their inventors. In *Cassell's Magazine* for 1885, on page 639, there appeared the following paragraph:—

"A DRY BATTERY.

"According to recent researches of Dr. Onimus, voltaic batteries containing ammonium chloride and zinc chloride can be converted into dry piles by mixing these solutions with plaster of Paris, and allowing the mixture to solidify. If the mixtures of ferric oxide and manganese peroxide with plaster of Paris are employed, the electromotive force is slightly higher than with plaster of Paris alone; and when oxide of iron is used, the battery quickly regains its original strength on breaking the circuit. When the battery is exhausted, the solid plaster of Paris has simply to be moistened with the solution."

Fig. 2.—Oval Cell.

In 1886, an able physician and electrician, named Dr. Gassner, residing at Mayence, introduced a dry battery, resembling that ascribed to Dr. Onimus in *Cassell's Magazine*. As this battery met with a favourable reception on the Continent, it was forthwith patented in Germany, Austria, France, Belgium, Italy, England, the United States of America, and in Brazil. It was also tested by able electricians in Belgium, England, and America, who pronounced the battery the best of its kind for all such work as electric bell ringing, telephones, and electric telegraphs.

The Gassner Patent Dry Battery is composed of cells made entirely of thick zinc, which serves the double purpose of an unbreakable case for the contents, and the positive electrode of the battery. These zinc cases may be made in any form and of any size required; but the sizes and shapes now in general demand are as follows:—

No. 03.	Small oblong cells, $3\frac{1}{2}$ in. × 2 in. × $1\frac{3}{8}$ in.	
,, 15.	Tall circular cells, 7 in. × 3 in.	
,, 16.	Tall oblong cells, $6\frac{1}{2}$ in. × $3\frac{1}{4}$ in. × $1\frac{3}{4}$ in.	
,, 17.	Tall square cells, $6\frac{3}{8}$ in. × $3\frac{1}{8}$ in. × $3\frac{1}{8}$ in.	
,, 19.	Tall oval cells, $5\frac{9}{16}$ in. × $3\frac{1}{16}$ in. × $1\frac{5}{8}$ in.	

A pad of rubber, or some similar insulating material, is placed in the bottom of each case to insulate the zinc from the carbon element; and the case is then packed with a mixture composed of gypsum and protoxide of zinc, specially prepared, made into a paste with a strong solution of sal-ammoniac and chloride of zinc. A plate, block, or hollow cube of special porous carbon is then soaked in a depolarising liquid and pressed into the pasty mass above mentioned, which soon sets hard and firm around the carbon. The square cell (No. 17) is divided by a zinc partition into two equal parts, each containing a block of carbon. This increases the exposed surfaces of the two elements, and ensures a corresponding low internal resistance to the cell. The small cell (No. 03) is furnished with a cube of hollow carbon. The tall oblong cell (No. 16) is enclosed in a case of vitrified iron, which gives it additional strength and adds an attractive exterior appearance. Each carbon is furnished with a terminal binding screw, as in the Leclanchè battery, but a piece of stout copper wire is soldered to the zinc case for connecting purposes. The top of each cell is sealed with a resinous composition, and this is stamped with the letter G.

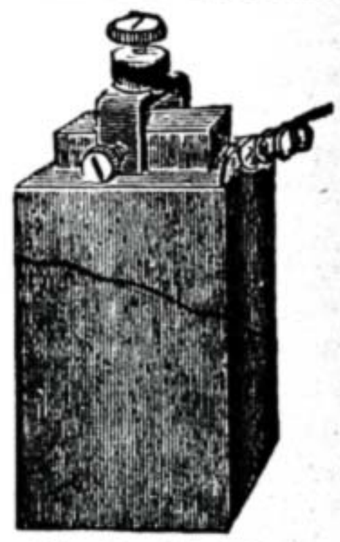

Fig. 3.—Flat Cell.

It will thus be seen that the Gassner dry

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battery possesses an advantage over those enclosed in cells made of glass or stoneware, as there is no danger of breakage of cells. There is no liquid to spill, its place being taken by the deliquescent salts of zinc and ammonium chloride combined with gypsum. The cells can therefore be placed in any position—on their sides, or even upside down if necessary, and packed away on a shelf if required—without injury to the battery. There are no fumes given off whilst at work, nor any corrosive salts formed, nor any porous cells to be choked with salts. It may be carried about in any position, and subjected to the motion of a boat, ship, or carriage, without any inconvenient results. It will work in the high temperature of boiler-rooms and in hot climates, and is not affected by severe cold, because there are no liquids to be evaporated or frozen. As no chemical action or short circuiting can take place in the cells, they may be packed away for months or years, and be always ready for use when required.

Such are some of the advantages claimed for the Gassner battery; but the crowning peculiarity remains to be noticed. It will yield a current having an electro-motive force of 1·60 volts per pair of elements for a much longer period than the Leclanchè cell, and when exhausted, can have its strength renewed by charging it with current from a dynamo or from a powerful battery, much the same as an accumulator is charged. In fact, it is a primary battery and an accumulator in one. A cell tested at the Liège University, under the auspices of Professor Gérard, was placed on short circuit for 18¼ hours, when its electro-motive force gradually diminished from 1·508 volts down to 0·1015 volt. It was then charged with an 0·5 ampère current for thirty minutes, during which time its electro-motive force rose from 1·13 volts to 1·680 volts. The current was then augmented for the next thirty-five minutes to 0·8 and 1·0 ampère, when its electro-motive force rose to 1·89 volts. During 4 hours and 20 minutes, 0·75 ampère of current was sent through the cell, and its electro-motive force was raised to 2 volts. It was then put on a closed circuit for another 18¼ hours, during which time its current gradually failed until it reached 0·100 volt. The battery has also been tested at the General Post Office in London, and at other places, with most satisfactory results.

Through the kindness of Mr. P. C. Brewster, of 12, Addle Street, London, E.C., who is acting as Dr. Gassner's representative in this country, we have not only been furnished with the foregoing particulars respecting the battery, but have also had several of the cells placed at our service to be tested for endurance and capacity for recuperation. The tests made with these fully verify those made at the Liège University. A No. 16 cell was connected up to a 2 in. bell day by day, working continuously during a day of nine hours, and resting at night. During the first four days its vigour was fairly maintained, and it was disconnected at night in good condition. During the remainder of the time whilst it was being tested, it ran down during the day and stopped ringing the bell, because it had not enough energy to continue the action; but after a night's rest, it came up to the work fresh the next morning. As the daily tests went on, its period of spirited activity grew shorter, until, after doing 118 hours' work, it was found to be quite run down. This was a severe test for an electric bell battery, and would have ruined a Leclanchè cell. We then connected it to a small dynamo, and sent a current of electricity through it from carbon to zinc for a few hours, until its vigour was completely restored. The electro-motive force of each cell entrusted to us was about the same as that of the Leclanchè, but the internal resistance varied with the sizes of the cells. The larger cells have an internal resistance of from 0·50 to 0·21 ohm.; the smaller cells have an internal resistance of over 1 ohm. As the volume of current obtainable from a battery cell is largely affected by its internal resistance, the larger cells will furnish a much larger volume of current than the largest Leclanchè, and should be more suitable than these for lighting small electric lamps. To jewellers doing a small electro-gilding and electro-silvering trade in their own workshops on small articles of jewellery, the larger-sized (No. 17) double-carbon Gassner cells would be a boon, since the battery would not require any cleaning, and would be ready for work at any time. One or two of those cells in series would furnish sufficient current for gilding and silver-plating a few small articles, such as brooches, studs, pins, and rings.

It should be understood that the constancy of a battery depends more upon the depolariser employed in the cell than on the exciting liquid or paste acting on the zinc. If the depolarising substance is present in the cell in sufficient quantity, its action will be long sustained; and if this substance yields up its oxygen freely to the hydrogen formed at the surface of the negative element, a constant electro-motive force is ensured. When the hydrogen clings as a film to the surface of the carbon plate, or gets shut up in its pores, the electro-motive force of the cell falls, and is not restored until the hydrogen is thrown off or absorbed. In the Leclanchè this polarisation of the cell is most marked, hence it can only be employed for such intermittent work as bell-ringing, telephones, telegraphs, medical coils, etc. The Gassner cell does not so readily polarise, and its depolariser soon absorbs the hydrogen determined to the negative element.

The exact composition of the excitant and of the depolariser is kept a secret by the makers, so we are unable to state what may be the action going on in the cells when the battery is placed on a closed circuit.

We have pointed out to the makers a defect in the construction and finish of the cells. The absence of a terminal binding screw to the zinc cylinder is a source of inconvenience when the connecting wire is broken off. If the makers can solder a small screw to the zinc case in addition to the copper wire, the battery would receive more favour from English customers. Complaints have reached us of inability to get the cells recharged. There should be no difficulty about this. Anyone having a shunt wound dynamo can recharge the cells by connecting the carbons to the positive pole of the machine and the zinc to the negative pole. Any number of cells may be charged at once in series if the electro-motive force of the charging current is kept above that of the combined counter-electro-motive force of the fully charged cells—viz., 2 volts per cell. A Bunsen or bichromate battery will serve the purpose of recharging the exhausted Gassner cells. The recharging current must exceed that of the current expected from the battery by at least 10 per cent.—that is to say, if we require the battery to furnish a current of 0·5 ampère during a period of eighteen hours, making in all 9 ampère hours of current, we must send a 0·5 ampère current through the cells for twenty hours, or a 1 ampère current for ten hours. Having exhausted the chemical energy put into it at first, we must put into it an equal amount of energy to restore its strength.

Mr. Brewster informs us that the battery has a host of imitators, and imitations of the Gassner cell are being sold. The real cell bears Dr. Gassner's name on the carbon and on the wrappers around the cells. Only a few agents have been appointed for their sale in England, but several thousand cells have been already sold. The price is 4s. 6d. per cell.

THE ART OF FAN PAINTING.

BY E. CROSSLEY.

WOMEN who have leisure time which they can spend in painting fan mounts for their own amusement are to be congratulated. It is a most fascinating occupation. Some may start with the idea that it is an easy job to paint a fan. So it is if we know how to draw well, how to design, how to paint, and how to combine and blend our colours so as to produce perfect harmonies. Granted one knows all this, those who have tried their hands at fan painting will own there is yet more to learn. The treatment of fan mounts is an art in itself; quite different is it from ordinary water-colour drawing. The designs, unlike as they may be to each other, must all be specially suited to the purpose. Without question, the only way to become a thoroughly good fan painter is to study the old French artists' works. What modern can equal the grace, vivacity, brilliance of tone, and delightful harmonies in the subjects of Boucher, Watteau, and Lebrun? There are a few who, by continued close following in the footsteps of Louis Quatorze and Louis Quinze times, have made the spirit in which they worked their own, and these are the most successful. They are no mere copyists, but they are followers of those who lived when the art had attained its highest perfection, and who, in fact, made it what it was. The method, too, of colouring subjects on fan mounts is very different to that we should adopt when painting a picture—that goes almost without saying—but it also varies from that employed in decorative art work generally. This we shall see later on.

Our first consideration shall be the requisites for fan painting. As I am writing this article to assist those who have never before attempted fan painting, it will be best to go fully into detail. Of course, I take it for granted that those who intend to try know how to draw, and have, at least, had some practice with the brush; but of *fan painting* I shall take it for granted they have no experience. Now as to colours. These should be fresh and of the best quality. Body colours, viz., colours mixed with white, are sold in tubes by some of the best artists' colourmen. It is as well for those who think of making a study of decorating fans to invest in these. But for a beginner, who may only make a trial of it and perhaps not care to follow it up, the wisest plan decidedly is to purchase ordinary water colours, and to add Chinese white when using them. A short list will be useful. Yellows—Naples, cadmium, Indian, lemon; blues—cobalt and ultramarine; reds—crimson lake, burnt sienna, and carmine; greens—sap, Hooker's, chromium, and emerald; browns—sepia and Vandyke; greys—neutral and Payne's

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grey; ivory black. These, with the indispensable bottle of fresh Chinese white, form quite a sufficiency, though more can be added at discretion when some progress has been made. It is not in the number of colours at hand that success is secured, but rather in combinations of a few that harmonise well: this shows the real artistic skill, the power to get good effects by simple means.

Next come a few words about brushes. These should be thoroughly good and new; it is impossible to paint fans that need such nicety of work if the tools are of inferior make, too much worn, or have been used for oil painting. The hairs of the brush must come to a good point. One large, one medium, and two small brushes will be found enough.

For sketching the design and for transferring it, a drawing-board, pencils, drawing-paper, tracing and transferring-papers, will be required. The first of these papers is not needed if the worker is a fair draughtsman, as the sketch can be made on the tracing-paper at once.

For preparing materials such as paper, silk, and all textiles, a stretcher, isinglass, and a soft broad brush must be obtained. I will describe the manner of preparing these, as some may wish to know how to do it themselves, but I advise generally the purchase of fan mounts ready prepared. They are kept at the best shops where fans are sold. It saves the trouble and the time that would be spent in preparing, and also saves the expense of procuring a stretcher. Certainly it is wisest to buy the mounts ready if only a few are to be used. If anyone intends to make a business of fan painting, it will probably be less expensive personally to prepare the mounts.

To make the size, an ounce of isinglass is to be put in a pint of water and left to soak for a night. The vessel containing it is then placed in one holding hot water until the isinglass is thoroughly dissolved. The size is used warm. Cut the material of convenient length and breadth for the stretcher; lay it on the stretcher, after having brushed the size over both sides; stretch it whilst wet. When dry, cut out the fan mount the size and shape you require, but allowing half an inch margin beyond all round. The selvedge of the fabric must run lengthwise. Some artists do not prepare their mounts at all: they use a medium such as Miss Turck's.

There are many materials suited for fan mounts. Vellum stands first; nothing equals the beauty of it when it is decorated by a clever artist. Satin, silk, gauze are all more fashionable for the time being, but vellum is the most artistic, and as it always has been, so it always probably will be, the favourite mount of the best fan painters. On it can be executed real works of art; paintings are capable of being worked up to the perfection of ivory miniatures; it is hardly possible to obtain too high a finish, and the most elaborate subjects can be carried out with perfect success. The very best practice one can have is to copy once, twice, or thrice, if needs be, an old fan painting on vellum, until something like a fair replica is produced. But the old fan should be a really good one, done by a French master of the art, if it is possible for the student to beg, borrow, or steal such an example. Another good plan, if one does not wish to make a servile copy, is to adapt, say, one of Watteau's subjects, and then to have an old French fan at hand from which the right tone of colouring may be learnt. On the harmony of colour, on the soft, reposeful, satisfying *tone*, more of success depends than on anything. The subject might be all we could desire, the drawing might be irreproachable, but if the colouring was harsh, crude, or gaudy, the fan would be a failure.

Next to vellum comes silk—faye and taffeta. On silk mounts elaborate subjects may be attempted, but fewer details will be introduced than when vellum forms the ground on which the painting is done. After silk, satin may be tried, but it is more difficult to work on. Simpler subjects are chosen for it—in fact, flowers tell best on it, as they require no background. Then there is gauze, which makes the lightest, daintiest mounts of all. On it a *grisaille* is simply charming. Areophane can hardly be known from gauze at a little distance; it is fashionable just now, and very pretty paintings of figures or flowers can be executed on it with but slight labour. They must be quickly done to be artistic; it is quite impossible to work up a painting on these two fabrics. Of paper fan mounts there is no end. We are inclined to look upon them as common, because there is such a large supply of them now in the market. But beautiful paintings may be done on paper fan mounts. It is a mistake to think that because slap-dash paintings on paper fans are turned out wholesale, all such fans must be inferior and inartistic. The paintings can be worked up to a high state of perfection, and the India-paper and fan-paper will be found easy to decorate. For this reason a beginner had better employ it than satin or gauze if a real study of the art is to be made. This is in all probability advice thrown away; amateurs are specially fond of trying the most difficult things; they hope to find a royal road, and to overcome obstacles at a bound. However, it is as well not to be too humble-minded as to our powers; if we think we are going to produce a masterpiece, we shall be sure to do our best, whereas if we only expect to turn out a daub, we shall in all likelihood do just that and no more. A little vanity is a great help towards success.

To stretch the mount ready for sketching and painting, moisten the edge with gum, then press it down on a drawing-board, making it lay as smooth and taut as possible; then leave it to dry. Many workers fix their mounts with a few drawing-pins; but this is not a satisfactory method.

Artists who understand fan painting well, and who have had much practice in it, often sketch in the subject on the fan mount without even making a preliminary sketch on paper. Beginners will do wisely if they make a correct drawing first on paper, and copy it or trace it on to the fan mount.

To trace the correct drawing, which has, we will suppose, been made on drawing-paper, lay a sheet of tracing-paper over it and "take off" the drawing by going over all the lines with a fine lead pencil. To transfer this drawing on to the mount is the next process. Take a sheet of red transferring-paper and rub off all the colour you can, otherwise it will soil the fan mount; enough will remain on to answer your purpose. Lay it, colour side downwards, on the mount. Over it place the tracing you have made, taking particular care to get it in the right position. Now go over every line with an ivory tracer, holding it upright, and not pressing too heavily, or the lines made on the mount will be thick. The tracing must be firmly fixed with needles before commencing. Another plan that gives less trouble, but needs a good draughtsman to follow it, is to make the sketch direct on the tracing-paper; this saves "taking off" the sketch from the drawing-paper.

On vellum or fan-paper the sketch can be made with a soft pencil, but it should be used lightly. Vellum requires no sizing or preparation of any kind. To stretch it, wet the parchment with a sponge dipped in water; whilst damp, fix it to the board by gumming the edges, and pressing it down until it adheres.

As much the chance of success depends on the subject chosen as on the manner in which it is carried out. There is great scope for the designer to show his skill; seascapes, landscapes, national sports, and *genre* pieces are all suited for fan decoration, whilst the worker who copies or adapts from masterpieces has countless excellent subjects ready to his hand. From engravings of the works of old and modern French artists, and several of the English too, charming *morceaux* may be obtained, and as for suggestions, they can be had without limit. Allegorical and mythological themes are specially admirable; these are always painted on vellum, chicken-skin, or paper. They are executed with all the care bestowed on a miniature, with much elaboration of detail, and the fan sticks are highly ornamented. Water looks especially well on silk and satin mounts, when introduced with a slight background of trees and a peep of an old castle. More often than not in such a subject two or three figures occupy the foreground in costumes of the olden time; or maybe, a nymph disports herself on the water's edge, whilst others rest on the grass beyond. Sprays of well-arranged flowers are beautiful decorations for satin and silk mounts, but they need to be well done, otherwise they can only be regarded as commonplace. Lilac makes a charming decoration for a mount of a lighter or darker shade of lilac-tinted silk. The rarer kinds of orchids have not been "commonised" so far.

Now we will consider the method of carrying out our chosen subjects, whatever they may be, always supposing they are artistically designed and correctly drawn. Monochromes are done in one colour only, but with lighter and deeper shades of the same colour to "bring out" the subject, and to heighten the effect. Say we are painting a spray of flowers. The darker petals of the flower are laid in first with a deep shade, then lighter ones are put in, and, lastly, the lightest petals are filled in. Then all are touched up with washes, and the high lights added. All lights are rendered with Chinese white, and all colours have Chinese white added to them on the palette. On delicately tinted pink, green, or yellow gauze, or areophane, *grisailles* are most attractive. These and monochromes are easy for beginners, for they have not to consider the blending of different colours into a harmony—a most important consideration in fan painting generally. In a *grisaille*, black, grey, and Chinese white are employed; the shadows are warmed with brown, or a little pink is touched in here and there. Imagine a bewitchingly costumed damsel of the eighteenth century is represented in this method on a silk or gauze mount; all her costume will be done in black and grey, and white touches for the high lights, but the rosettes on her shoes, the ribbons at her elbow and throat, will be given in a delicate shade of pink.

In painting a *genre* piece or a landscape, a thorough knowledge of painting is a vast assistance to the student of the art of fan painting. Those who understand the combination of colours so as to produce without

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trouble good harmonies, those who understand how to contrast colours to secure pleasing effects, have but little to learn, and only need some practice to perfect themselves in the art, although it differs, as has been said, from the painting of pictures. Take landscapes, for example. First the skies are put in, next the distance, lastly the foreground. For trees, emerald green and pink if they are in the distance; if in the foreground, they are painted in a quiet shade of green. For castles, and so on, in the distance grey tints are used, with slight touches of yellow. Water is represented with bluish-green tints, with white added to the colour, and the lights with Chinese white. But all this is most easily accomplished if the worker has a well-painted fan to copy; once done, practice will make him proficient. In *genre* pieces the flesh tints will be given with lemon-yellow, just a mere touch of vermilion, and Chinese white. Silk and satin need the addition of more Chinese white to the colours than vellum, paper, or skin. The use of too much white is altogether detrimental to the painting, as it will cause the colours to crack; this is always specially noticeable in the portions of the painting that come just in the folds of the face mount; to avoid this, due care must be taken: still, a certain amount of white is absolutely necessary to give substance and a surface that will permit the laying on of finishing washes and touches.

Gauze fans are extremely attractive, and are also most fashionable. For the time being gauze and such-like semi-transparent materials are more popular than anything else for fan mounts. On gauze, and materials resembling it, drawing or tracing the subject is out of the question. The only method possible of indicating the outlines of a subject is to sketch them in with a brush filled with colour or Chinese white: the latter is employed for a *grisaille*; lake for a painting. Gauze is now dyed the most delicate and lovely tints imaginable, to suit all the newest materials used for costumes.

Novelties even in fan decorations are constantly appearing. Here is one of the very latest. A pink silk fan mount has three oval medallions of lace inserted. Spreading out irregularly and carelessly round the medallions are groups of tiny roses of a deeper shade of pink: these are arranged somewhat in the style of a wreath, but stand up much higher, and spread out more broadly at the sides than at the bottom of the medallions. On the right half of the fan mount a further ornamentation of ribbon is introduced. Two lengths of ribbon half an inch in width, corded, and with plain satin border on both sides, are arranged as follows: One ribbon is blue, one pink, and both are snipped out to leave two points at each end. A long end of the blue ribbon is gummed to the mount, then it is turned sharply over and forms a flat bow; the ribbon must be turned over inside out three times to manage this, and the bow is of triangular form; then comes another bow; then the blue ribbon is tied to the pink one, which meanders over the silk till it reaches the outer stick much in the same way. All the ribbon is gummed down, and over it is placed a fine lace insertion.

I will conclude by saying that if any of our readers wish at any time to receive suggestions for subjects suitable for fan painting, or to hear of novelties in this direction, I shall be glad to give them an answer in "Shop." Like the rest of the contributors to WORK, I am always ready to lend a helping hand whenever I am able to do so.

THE MECHANICAL PROCESSES OF SCULPTURE.

BY MARK MALLETT.

CASTING IN PLASTER.

WORKING ON PLASTER—PLASTER TOOLS—WAX MOULDING.

As regards working upon models after casting, the majority of those best qualified to speak with authority do not greatly recommend it as a thing to be practised. Most good modellers will tell you that it is rather desirable to finish a model so thoroughly in the clay that nothing may remain to be done in the plaster.

We incline very much to this opinion ourselves, but it is not a matter on which any hard and fast rule can be laid down. The small accidents of casting frequently render some little plaster work imperative, and there is a very respectable minority among modellers who prefer leaving a great deal to be done in the less plastic material. The great Flaxman, when making his wonderful reliefs, such as his "Shield of Achilles," is said to have merely roughly sketched the figures in clay, and to have elaborated all detail and finish in the plaster. Continental modellers work much more in this material than we do, and with some of them it is not unusual to entirely build up and work even life-sized figures in it. We might also instance a living English artist of high repute who prefers plaster to clay for modelling the details of works on a large scale. Plaster work is not therefore a matter to be left unnoticed.

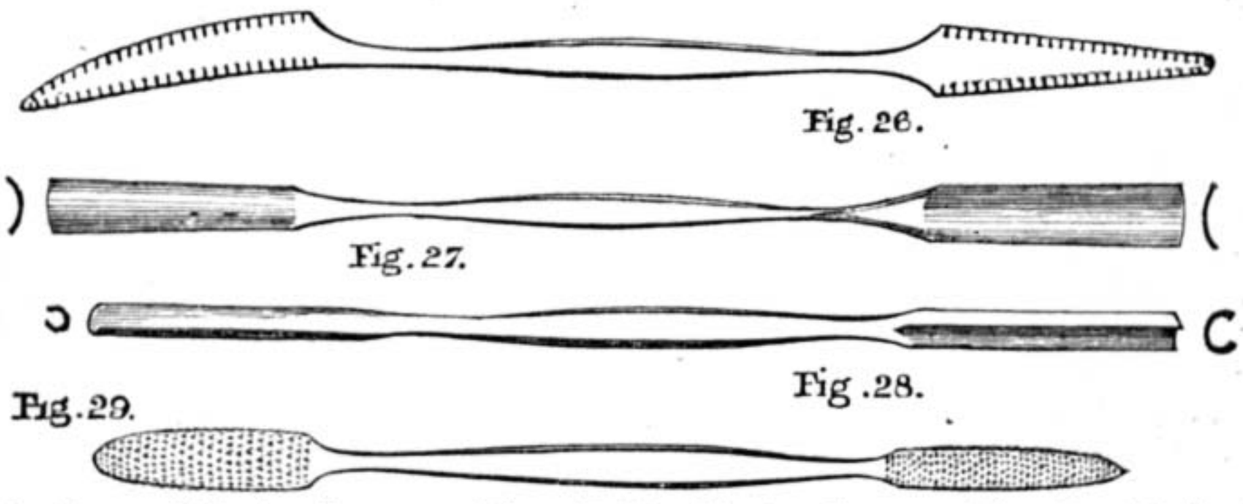

Fig. 26.

Fig. 27.

Fig. 28.

Fig. 29.

Fig. 26.—Saw-set Plaster Scraper. Figs. 27, 28.—Plaster Gouges. Fig. 29.—Plaster Riffle.

Work on plaster, as Flaxman and some others have worked, may be said to be somewhat akin to carving, from which, however, it differs in this respect—that it is almost as easy to add as to cut away. The actual modelling in it—the building-up of forms with spatula and trowel—is only possible in that short space which elapses before the plaster sets; consequently, whoever attempts much in it needs to know what he is about, to have a clear conception of the form he wants, and to have the knack of producing that form quickly. It is hardly work for a feeble modeller or a novice. Indeed, except for very rough purposes, it is scarcely to be recommended to the ordinary figure modeller. In producing ornament, it may, however, often be resorted to with advantage, as saving time and giving good results.

To most figure modellers plaster work is merely supplementary to their work in clay. Pleased as the tyro usually is when he sees his work come from the mould a snow-white cast, he will probably find, as he examines and turns it to different lights, that this brilliant material reveals many faults which had escaped his notice in the dull clay—much of his modelling which he had before thought soft and finished will now look crude, and what seemed to him well-curved surfaces will now prove "lumpy:" naturally, he will desire to correct these shortcomings.

Before he does so, he must be warned that if he once begins working on a cast, he can scarcely stop till he has worked all over it—so different will be the surface from plaster work to that left by the clay. But if he resolves to touch-up, he should do so whilst the model is fresh from the mould; for if allowed to dry, the plaster gets hard and works badly, and will have a scratchy look.

Some of the most useful tools for the present work are scrapers. One of these, combined with a spatula, is given in Fig. 23 (p. 399). This has serrated edges—edges with minute saw teeth—and this is the ordinary form of such tools. A much improved scraper is, however, that shown in Fig. 26. This has a tooth more resembling a saw-set; it works better, and leaves a far better texture on the plaster than the last-named tool. Small gouges of various sizes and curves, of which examples are given in Figs. 27 and 28, will also be found handy. Other plaster tools are "riffles," one of which is shown in Fig. 29. These are diminutive rasps, and they would be more desirable if their tendency were not quickly to choke, and then to rust and become useless. They are good for working in hollows, but over most parts of the cast a piece of glass-paper makes the best riffle, and this, as soon as choked, can be thrown aside and a new one taken. Glass-paper is invaluable for plaster work. For removing lumpiness upon broad surfaces nothing else should be used. The sizes to be bought are Oakey's fine and middle No. 2; coarser scratches and finer do not bite enough, and choke too soon. Before using, two pieces should be lightly rubbed together: this takes off any unduly projecting particles of glass, which otherwise might make ugly scratches. For fine work—small medallions and the like—very small spoon-shaped ivory or bone modelling tools will be found of use on plaster. Any of the tools above-mentioned will probably cost from 6d. to 10d. each.

Whilst we are on the subject of plaster work, mention may be made of a method recommended for rendering this material more plastic, and therefore better adapted for modelling in: this is by the addition of marsh-mallow root (*Althea officinalis*). Two to four per cent. of this root finely pulverised and mixed with plaster is said to retard the setting of the latter for about an hour, and it may during that time be modelled like clay or wax. The root may be added up to eight per cent., the larger quantity retarding setting still longer, but making the mass more tenacious. When set, this mixture is reported to be so hard and tough as to admit of being turned or worked, and polished like ivory. The method is one which recommends itself for fancy and

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ornamental purposes, though it has not been adopted by figure modellers.

In order that these papers may be as complete as possible, I propose to show how casts are to be made from many other objects than clay models, and this will be done by the same process of waste moulding with which we have thus far had to do. But before speaking of casting from Nature, it will be well to speak of another kind of waste moulding sometimes used for moulding from clay. This is *wax moulding*. In very delicate models, more particularly models of ornament, the character of the work sometimes depends on sharp points and edges, with deep undercuttings beneath them, and these would be ruined by any attempt to chip a mould from them in the ordinary way. The moulder, therefore, pours a coating of melted wax over his model, and this forms his inner mould. He then makes his outer mould of plaster in the ordinary way. When the mould has been filled and the outer mould broken off, the cast is placed before the fire: the wax mould softens in the heat, and can be presently peeled off, leaving all the delicate modelling uninjured.

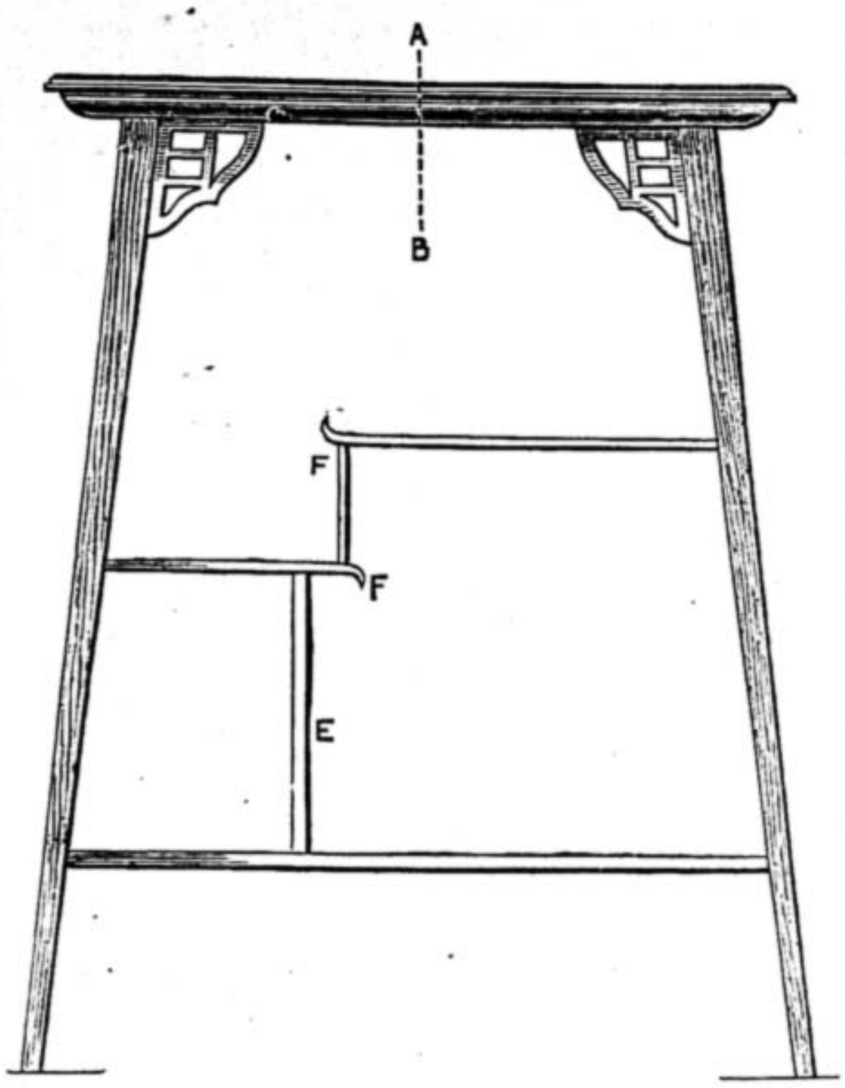


Fig. 6.—Front Elevation of Table. (Scale, 1½ in. to 1 ft., or one-eighth size.)

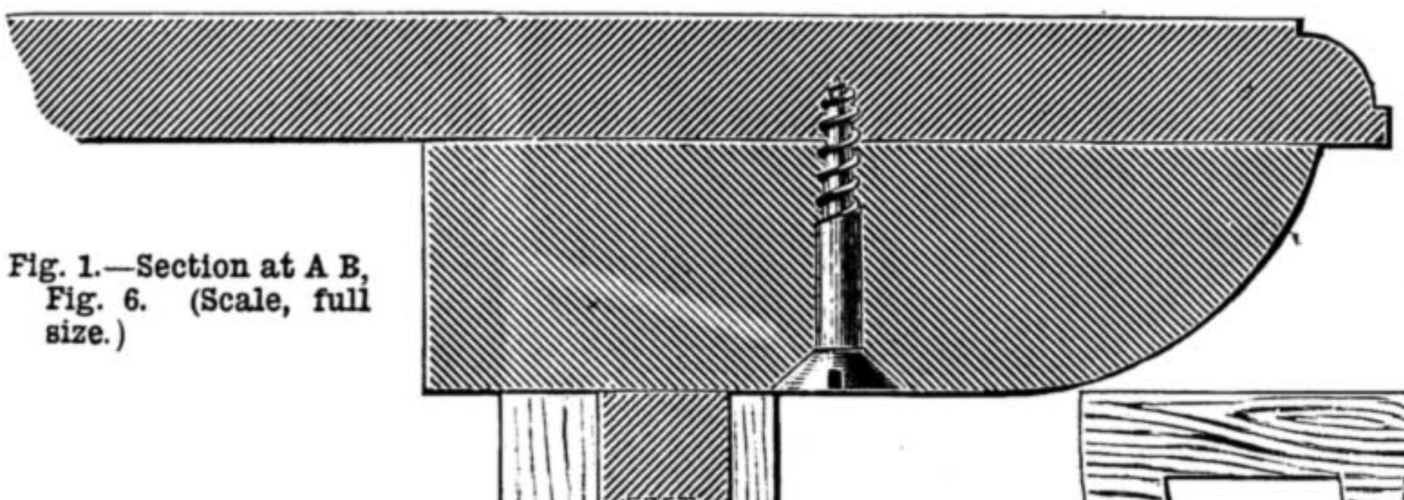


Fig. 1.—Section at A B, Fig. 6. (Scale, full size.)

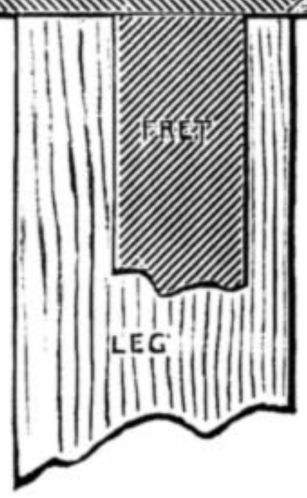
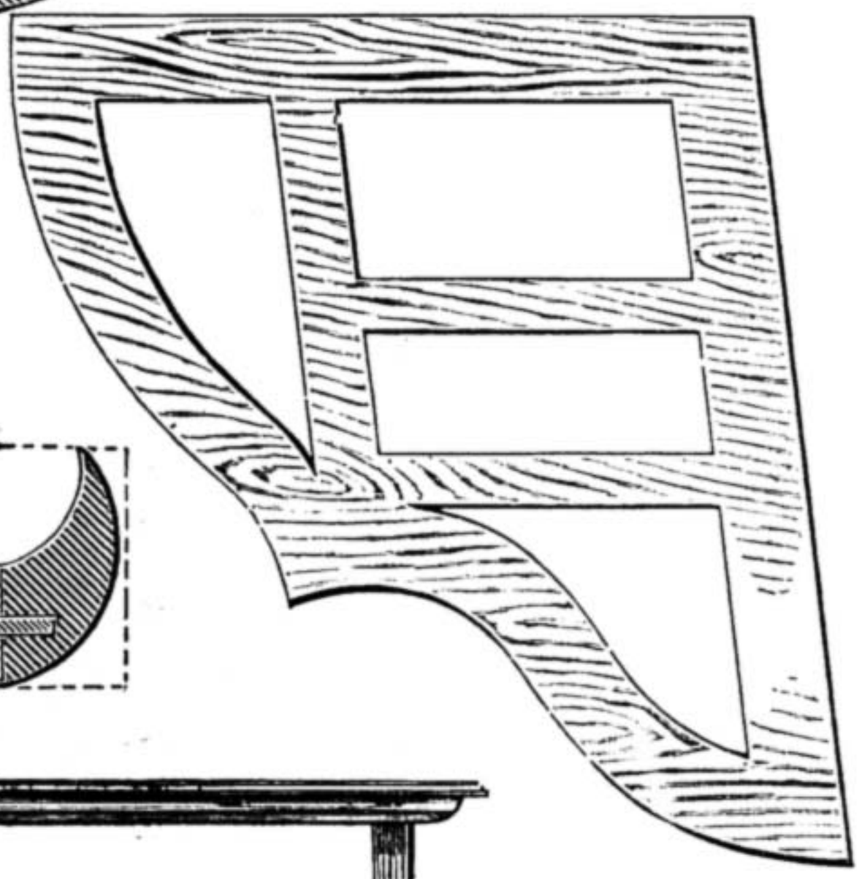


Fig. 4. — Fretwork in Corner Angles. (Full size.)



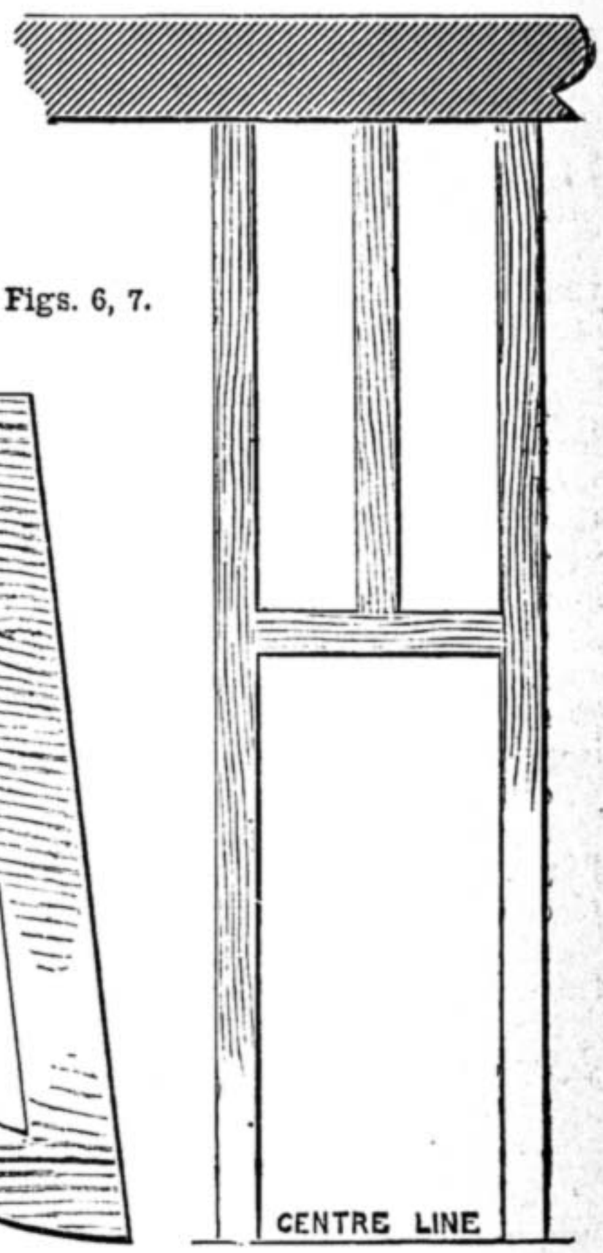


Fig. 5.—Elevation at E, Figs. 6, 7. (Full size.)

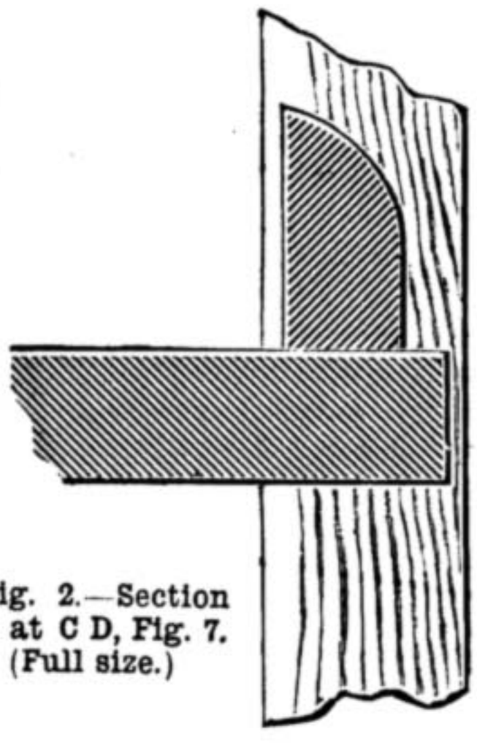


Fig. 2.—Section at C D, Fig. 7. (Full size.)

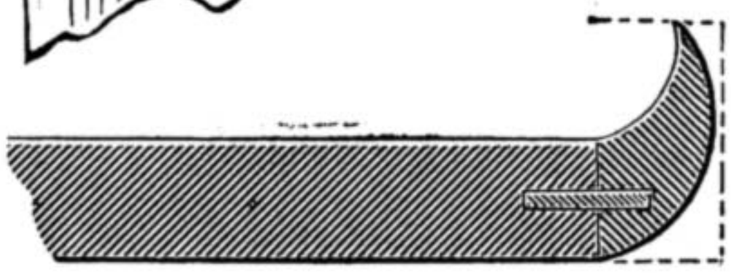


Fig. 3.—Section at F, F, Fig. 6. (Full size.)

A USEFUL TABLE FOR BRIC-À-BRAC.

BY EDWARD C. ROE, JUNR., SILVER AND HONOURS MEDALLIST, CITY AND GUILDS OF LONDON INSTITUTE.

"WHAT a pretty, useful little table!" This expression came from a friend upon viewing a table very similar to the one about to be dealt with; and certainly I must agree with that opinion, and do not for a moment hesitate to believe that such will be the general verdict. In addition to its neatness and utility, we have the further beneficial fact, that such a table is very easily made, and is well adapted for construction by either amateur or professional workmen, for experience has taught that the latter fraternity dislike a too lengthy, and therefore probably tedious, job equally with their amateur brethren, and prefer a job which is capable of being produced in a few hours, but at the same time will reflect credit upon the maker.

The original is made of American white wood, stained and polished in a very charming lake-vermilion tint, if such a term may be used; however, I think it will bear my meaning. It is not my intention to enter into the details of the polishing process, preferring to leave the description of procedure to my *confrères* more learned in such matters. Many, however, will prefer, and with good reason, to construct the table in walnut wood, most probably of the American variety; should this course be adopted, the whole should be simply dull polished, and, if neatly made, nothing would look better.

The drawings are to the scale of 1½ in. to a foot, or one-eighth, and full size, namely: Figs. 6 and 7 to the former, and the remainder full size.

To proceed with the actual construction. We must first set out the work full size; it is really only necessary to set out half elevations of side and front, the main requirement being the spread of the legs, and the consequent bevel of the shoulders on top of legs. Let us first prepare the legs: they require to be got out not less than 2 ft. long, preferably a little more; the thickness and width at the top is ⅞ of an inch, and then tapered off to half an inch at the bottom: these are dimensions of finished work.

Should the top be taken in hand next, be careful that the stuff is free from shakes, etc., and above all quite dry; the extreme dimensions are 1 ft. 5 in. by 1 ft. 6 in. Plane up, taking out of winding carefully, for if this is not properly attended to it will lead to disastrous results. The ovolo (Fig. 1) should be worked on after carefully squaring the edges. Either a plane or a router, such as has been described in this Magazine, may be used for forming the moulding.

Be very particular when planing the top for a finish how your plane-iron is ground and sharpened; an iron sharpened square with merely the corners taken off is an abomination, and the result of work terribly disappointing, especially when ebonised or enamelled. What is required, and moreover is necessary, for the production of good work is an iron whose cutting edge forms a perfectly symmetrical curve from side to side, or in other words from corner to corner.

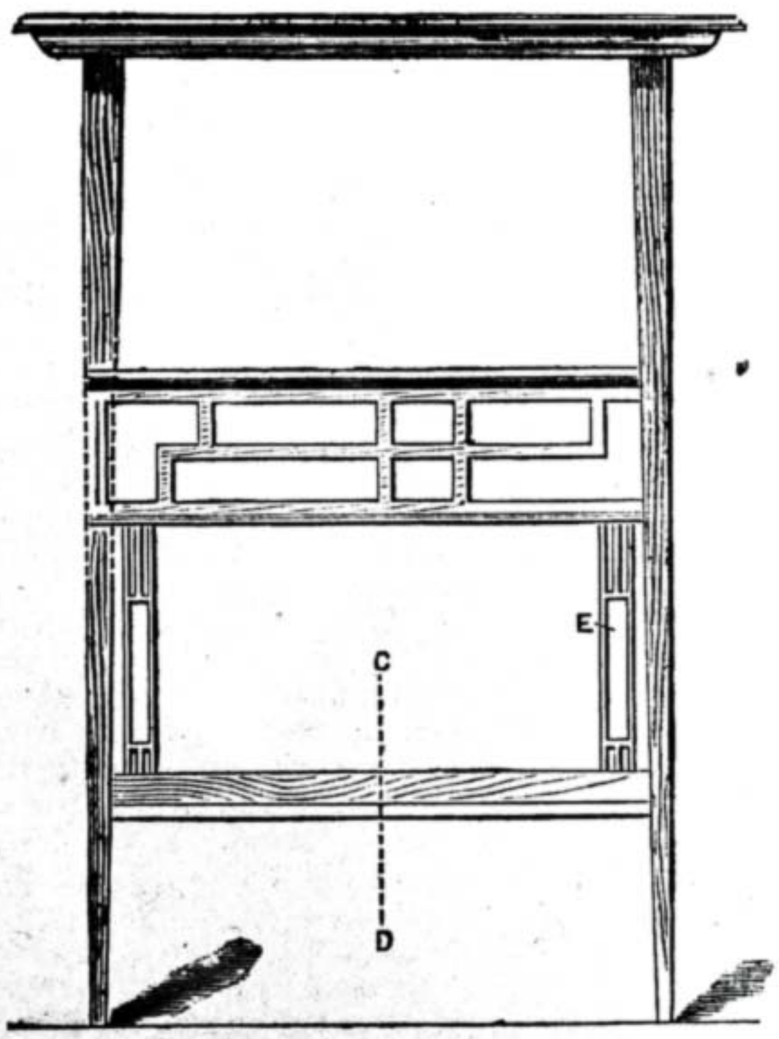


Fig. 7.—Side Elevation of Table. (One-eighth size.)

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Another minor, though important, matter, often passed lightly by, is the face of the iron, which very often, even in the case of the best quality iron, will be curved; such curvature is an unending and often unsuspected source of trouble, and such a serious defect should be sought out and remedied. An iron may be tested upon a surface plate, or in its absence by a small steel straightedge; the blade of a square will answer admirably if in good condition. These remarks apply more particularly to the varieties of planes used for finishing purposes, but should be kept in view always.

The pieces forming the round under the table top also act as clamps, and serve to keep the top from curling; they are in length finished 1 ft. 4½ in. and 1 ft. 5½ in.; two of each are worked to section (Fig. 1), then mitred round and screwed to under side of top. It is preferable to work all four pieces in one length. Let them be screwed on in a perfectly substantial manner, as the mortice for the legs will penetrate the joint. These mortices must be cut one way on the bevel; this will be readily seen upon reference to the full-size setting out; the mortice should be ⅝ of an inch square, thus allowing ⅛ of an inch shoulder on each face of legs. When carefully fitted, glue well, and then prepare the bottom shelf, which is shown in section in Fig. 2; the size is 1 ft. 6 in. by 1 ft. 2 in. approximately, the actual size being taken from the setting out or the table itself. Be sure to keep the grain lengthwise, so that the ledge (Fig. 2) may assist to keep it straight.

Doubtless the fitting of this shelf will cause a little trouble, but as great strength is not necessary, a method of fixing is to notch the shelf into the legs one way only, that way being the end where the legs are vertical, and on the sides where the legs spread to simply scribe to the bevel of legs. A thin screw run in skewwise will give strength quite sufficient for the purpose. The same remarks will apply to the remaining shelves, which should now be prepared. The curved edges, which serve to give a little character, are made in the manner shown by Fig. 3, the dotted lines representing the piece of stuff tongued on, and which is afterwards worked into the curves shown by the thick lines.

Note that in no case do the edges of the shelves come flush with the face of legs (see Fig. 2). Before fixing the minor shelves we must prepare the two vertical supports, as shown full size at Fig. 5, and cut the fret which comes between the second and third shelves. Some may possibly prefer to frame this fret together; such a method would certainly be neater, but is of necessity a much more tedious job. A portion of one leg in end elevation is removed in order to make clear the method of finishing end of fret.

The two ledges (see Section C D, Fig. 7) may be prepared and fixed with three or four fine screws from the under side of the shelf. By the way, an alternative and possibly a better method suggests itself for the purpose of fixing the bottom shelf. If the ends of the ledge be morticed and tenoned into the legs previous to fitting the shelf, it can then be fitted down on to the ledges without cutting into the legs, and then secured by screws.

The four angle frets, as in full-size elevation, Fig. 4, are ⅜ of an inch in thickness; the angle given (Fig. 4) must not be taken as perfectly correct, but the precise angle must be obtained from the table. The brackets may be attached with a few small French pins, preferably of the description having countersunk heads. I trust that my description will prove sufficiently definite, but should eager minds desire further enlightenment the "Shop" is open for their use, and any query addressed there shall have due attention.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of* WORK *for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of* WORK *without charge, the notices given partake in no way of the nature of advertisements.*

78.—Hunter's Patent Extracting Cowl.

Mr. Charles J. Hunter, 11, Countess Street, Whitley-by-the-Sea, sends me a very nicely-made working model of a chimney cowl, to which he has given the name of the "Patent Extracting Cowl." A rough illustration of the appliance is given in Fig. 1, and from this and my description combined, the reader may be able to form some general idea of its appearance.

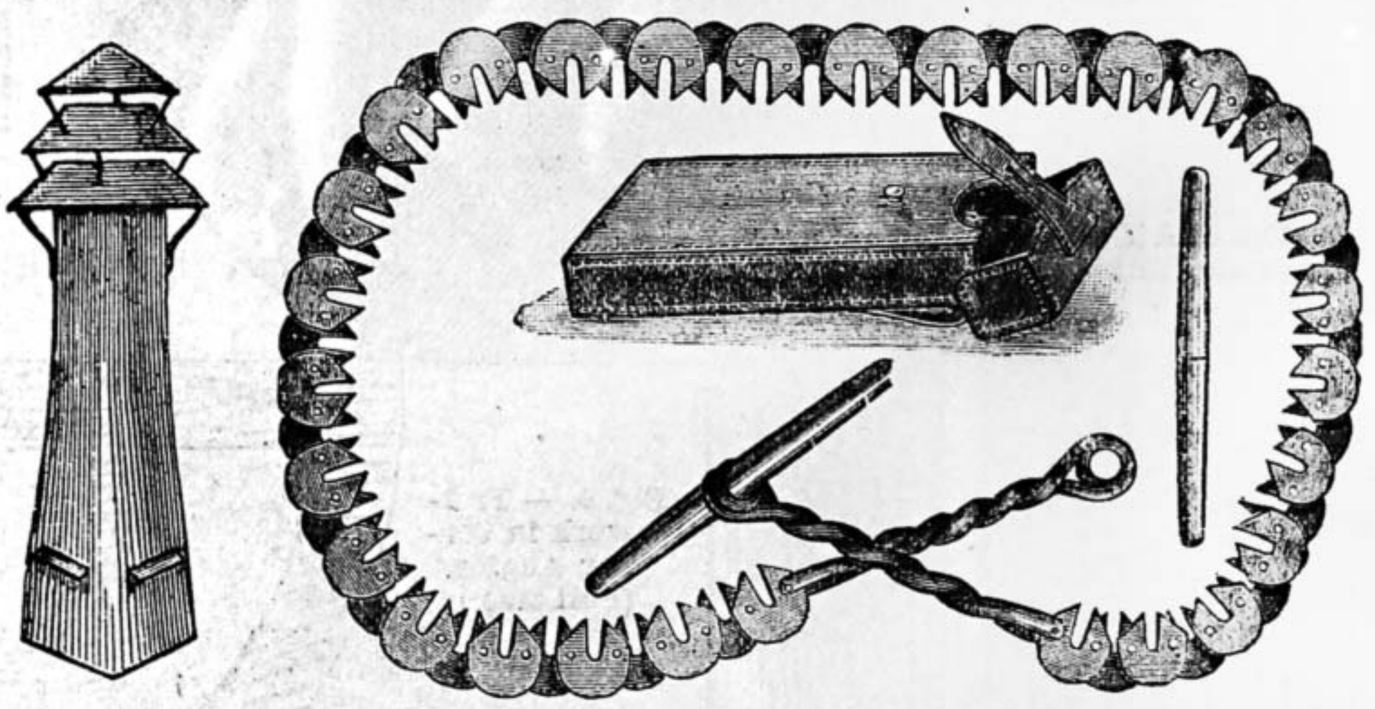

Fig. 1.—Hunter's Patent Extracting Cowl. Fig. 2.—Stanley's Portable Saw.

The shaft of the cowl is square at the base (I am speaking of the model before me), and assumes a rounded form about half-way up, which form is preserved up to the top. Immediately over the top, supported by three projecting stays, is a shallow saucer-shaped cap, open at the top, and having its lower edge nearly on a level with the top edge of the shaft. Above this is another cap of the same form, with an interval between its lower edge and the top edge of the cap below, and above this, at the same distance between, is a cap in the form of a very low cone with a broad base, which covers the opening. The construction, which is certainly simple enough, and contains no working parts to get clogged with soot or otherwise put out of order, is said by the maker to be most effective, and preventive of down draught and strong up draught, and is easily swept. Mr. Hunter gave me some directions for testing the model, as follows:—"To test, place the cowl over some scrap paper (some enclosed), blow with the rubber tube in all directions about the caps, and you will find the paper drawn out at the top. Or place the cowl over a lamp-chimney, turning the light *very* low, and you will find that the light will nearly be drawn out." Blowing as hard as I could about the caps, I raised a miniature hurricane around them—and I think Æolus himself could not have done it better—but the paper provokingly refused to come out at the top, and the lamp test was with me equally unsuccessful. But possibly I am getting stupid, and did not go to work the right way: in which case, without doubt, Mr. Hunter will set me right. I have only to say that prices may be had on application to Mr. Hunter at the address given above, and if any reader gives the cowl a trial, I should like to know the result, for it seems to be a good thing, though I could not make the model work.

79.—Stanley's Patent Portable Saw.

Who would ever have thought that a saw could be folded up and put in one's pocket? I never did until I saw Stanley's Patent Portable Saw, I must confess; and I daresay there are not many readers of Work who thought the thing feasible, or, perchance, ever gave it a thought at all. Nevertheless the saw exists, if I may use the term, and will be found of the utmost value to all saw users, as, owing to its extraordinary portability and, I may say, flexibility, it can be used for many purposes where an ordinary saw could not be used or carried. For military purposes, surveyors, emigrants, railway pioneers, miners, engineers, and settlers beyond the range, or on the fringe, of civilisation, the qualities already mentioned, and its compactness, will strongly recommend it. It will be found of great use in felling trees, especially as by its aid they can be cut level with, or, it is said, even below, the surface of the ground. The illustration of the saw given in Fig. 2 will at once show its nature and construction. It consists of a number of hardened steel plates, deeply notched at one part of the circumference up to the centre, and these are riveted together in double series, the rivets being sufficiently loose to form joints, on which the plates easily turn. The notching already referred to causes each plate to be shaped on one side to form a pair of saw teeth cutting in opposite directions. At each end of the saw is a short length of stout twisted wire, with a loop or ring at its outer end, into which a cross handle is slipped. These handles are withdrawn from the rings for packing. For inaccessible trees, branches, etc., ropes may be attached to the rings in place of the cross handles. The saw, when pulled out straight, is 6 ft. in. length, and therefore equivalent to a 6 ft. cross-cut saw; but it has this advantage over the ordinary cross-cut saw, namely, that it can be used by one man, who, of course, takes a handle in each hand. Its weight is only 2 lbs. 4 oz., including case, as shown in Fig. 2, which is 8 in. by 4 in. by 1¾ in. This, however, is the leather case used for Government purposes. Otherwise it is supplied in a wooden case, slightly larger, at 35s. It will be seen that the steel discs of which the saw is composed are plates circular in form, or very nearly so. The diameter of the plates may be put approximately at 1¼ in., their thickness being that of an ordinary cross-cut saw or thereabouts. The width of the notch is ¼ in, and the length about half the diameter of the disc. It has been said that it may be used by one man in cutting down a tree, but I should not like to be the man who was using it single-handed, for the cut would have to be commenced on the side of the tree furthest from him, and trees thus felled have a nasty knack of falling in the direction towards which the saw is working, and when the end came the sawyer might not have time to get out of the way.

The Editor.

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SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

NOTICE TO CORRESPONDENTS.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—LETTERS FROM CORRESPONDENTS.

Colouring Photographs.—F. M. P. (*Cockermouth*) writes:—"I see in your August number of WORK, Vol. II., page 278, *àpropos* of colouring photographs, E. B. S. recommends licking the photo to make the colour lie. I have seen it stated by very clever men on this subject that the saliva rots and eats away the albumen. I think a much better way is to use a preparation prepared by A. N. Rintoul, which will answer the same purpose and do no harm to the photo. It is easily applied, not expensive, and obtainable from, I believe, any artists' colourmen. I believe instructions accompany each bottle, but it is only necessary to wash the photo over with the preparation (twice if a very firm surface is required), and then to cleanse with a sponge and cold water; it also acts as a preservative to the photo."

How to fret a Banjo.—R. H.' H. (*Crewkerne*) writes:—"F. H. (*Streatham*) is quite right in saying that to divide the neck of a banjo into eighteenths will not produce the correct notes. The only correct method is first to decide exactly where the bridge is to be placed—3½ to 3 in. from edge of hoop is best; next divide the distance from the nut to the bridge by eighteen, and the first eighteenth is the place of the first fret; then divide the distance from the first fret to the bridge again to the bridge, and so on. Unless this is very accurately done, it is quite impossible to play correct chords with certainty high up the scale."

Correct fretting for Banjo, usual size—finger-board, 18 in.; hoop, 11 in.; nut to bridge, 26 in.

Distance from nut	*to fret*	*Distance from nut*	*to fret*	*Distance from nut*	*to fret*
inches.		*inches.*		*inches.*	
1·45	1st	9·55	8th	15·07	15th
2·82	2nd	10·46	9th	15·68	16th
4·10	3rd	11·32	10th	16·25	17th
5·32	4th	12·15	11th	16·80	18th
6·47	5th	13·00	12th	17·31	19th
7·56	6th	13·72	13th	17·80	20th
8·58	7th	14·41	14th		

Correct fretting for Brewster's grand orchestra-size Banjo—finger-board, 20 in.; hoop, 12½ in.; nut to bridge, 29 in.

Distance from nut	*to fret*	*Distance from nut*	*to fret*	*Distance from nut*	*to fret*
inches.		*inches.*		*inches.*	
1·61	1st	10·75	8th	16·80	15th
3·13	2nd	11·76	9th	17·48	16th
4·72	3rd	12·72	10th	18·12	17th
6·06	4th	13·63	11th	18·72	18th
7·34	5th	14·50	12th	19·29	19th
8·54	6th	15·30	13th	19·83	20th
9·67	7th	16·07	14th		

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Roof Strains.—STRAINS.—I give you a copy of Tredgold's rules and tables for finding the direction and amount of the strains on various parts of a roof, and the weight of the various coverings, which I think will give you all you want to know.

TREDGOLD'S RULES FOR SCANTLINGS OF ROOF TIMBERS.

B=breadth of piece in inches. D=depth of piece in inches. A=area of section of piece in inches= B×D. L=length of piece in feet. S=span of roof in feet. Tie Beam.—v=length of longest unsupported part in feet. When the tie beam has to support a ceiling only—

$$D = \frac{v}{\sqrt{B}} \times 1{\cdot}47 \text{ for fir, or } \times 1{\cdot}52 \text{ for oak.}$$

Ceiling joists 12″ from centre to centre.

$$D = \sqrt[3]{\frac{L}{\sqrt{B}}} \times 0{\cdot}64 \text{ for fir, or } \times 0{\cdot}67 \text{ for oak.}$$

King post.—$A = L \times S \times 0{\cdot}12$ for fir, or $\times$ 0·13 for oak. King bolt.—Diameter in inches $= \sqrt{S} \times 0{\cdot}2$. Queen post.—$t$ = length in feet of part of tie beam suspended by the queen post. $A = L \times t \times 0{\cdot}27$ for fir, or 0·32 for oak. Queen bolt.—Diameter in inches $= \sqrt{t} \times 0{\cdot}29$. Struts and braces.—$r$ = length of part of principal rafter, supported by the strut, in feet. $D = \sqrt{L \times \sqrt{r}} \times 0{\cdot}8$ for fir. $B = \frac{5}{6} D$. Principal rafters.—Supported by struts over which the purlins rest.

$$\text{In king-post roof—} D = \frac{L^2 S}{B^4} \times 0{\cdot}096 \text{ for fir.}$$

$$\text{In queen-post roof—} D = \frac{L^2 S}{B^3} \times 0{\cdot}155 \text{ for fir.}$$

The thickness is generally the same as that of the tie beam and king or queen posts. Purlins.—C= distance in feet that the purlins are apart. $D = \sqrt[4]{L^3 \times C} \times 1{\cdot}0$ for fir, or 1·04 for oak. $B = \frac{9}{10} D$. Common rafters.—$D = \frac{L}{\sqrt[3]{B}} \times 0{\cdot}72$ for fir, or 0·74 for oak.

Straining beam.—In the best form for strength, the depth is to the breadth, as 10 to 7.

$$D = \sqrt{L \times \sqrt{S}} \times 0{\cdot}9 \text{ for fir.} \quad B = \frac{7}{10} D.$$

TABLE OF ROOF COVERINGS AND INCLINATIONS, ETC.

The weights of coverings will vary according to the thickness, etc., of the materals used.

Kind of covering.	*Inclinaiton of sides of Roofs to Horizon.*	*Height of Roof in parts of span.*	*Weight on a square of Roofing in lbs.*
Asphalted Felt ..	3° 50′	1/36	30 to 40
Copper ..	3° 50′	1/36	80 to 120
Corrugated Iron, 16 B.W.G.I. ..	4° 0	1/25	350
Sheet Iron, 16 B.W.G. ..	18° to 20°	1/3	250
Lead ..	3° 50′	1/36	550 to 850
Slates (Large) ..	22°	1/2	900 to 1,100
,, (Ordinary) ..	26° 30′	1/2	550 to 800
,, (Small) ..	30° 0′	1/2	450 to 650
Slabs of Stone ..	39° 0′	1/2	2,380
Thatch (Straw) ..	45° 0′	1/2	650
Tiles (Plain) ..	30° 0′	1/2	1,800
,, (Pan) ..	24° 0′	1/2	1,200
,, (Taylor's Patent)	30° 0′	1/2	830
Zinc (1/8 in. thick) ..	4° 0′	1/25	150
Boarding (¾in. thick	26° 30′	1/2	250
,, (1in. ,,)	29° 30′	1/2	350

N.B.—The additional pressures to be taken into account in practice are the following:—Pressure of wind, 2,500 to 5,000 lbs. per square of 100 ft. Pressure of snow, 500 lbs. per square. I think the above will answer all your queries. Do not be startled at the formulæ, as they are only letters instead of words, and can be worked out by ordinary arithmetic. If you have the least trouble write again, but state clearly whether you want to know what weight the roof will carry, or what scantlings are required to carry a certain covering, or merely which members are in tension or which in compression.—E.D.

Size and Speed of Pulleys.—DICK.—A simple formula for the calculation of the speed and size of pulleys is $V \times D = v \times d$. V = velocity of driver—v = velocity of driven; D = diameter of driver—d = diameter of driven. For example, suppose a shaft runs at 80 revolutions, and carries a pulley 24 in. diameter, it is required to run another shaft from it at 100 revolutions, then the diameter of driven pulley will

$$= \frac{V \times D}{v} = \frac{80 \times 24}{180} = \frac{1{,}920}{180} = 10\tfrac{2}{3} \text{ ins.}$$

If you want to find v, $\frac{V \times D}{d}$ will give it, or if $V = \frac{v \times d}{D}$ or $D = \frac{v \times d}{V}$. If you have the velocity of a shaft, and want pulleys to drive another, first put down the revolutions per minute of driving shaft, and above place the revolutions at which the other is to be driven (in a practical form). This will give the ratio of pulleys, for if driving shaft = 50 revolutions and driven = 150 revolutions, then $\frac{50}{150} = \frac{1}{3}$, or driving pulley will have to be three times the diameter of the driven. When one or more counter-shafts are used between a driving shaft and a machine, as in your first question, the sizes of the various pulleys have to be surmised, and so substitute one for another until you get what is required to do the work. Your question says the shaft runs at 140, and carries a 26 in. pulley, size of spindle pulley 3½ in., and speed required 3,500 (which, by the way, I think is too high; the limit should be about 3,000, because the wear and tear of machine and belts would be very great; and the finish on the work would not equalise it). Cut down in the form of a fraction the diameter of all the driving pulleys, together with the speed of the driving shaft on the top line, and underneath put the diameters of the driven pulleys—the result will be the number of revolutions of the last driver's shaft, or in your case the polishing spindle. I will give an example or two. (1) $\frac{140 \times 26 \times 28}{9 \times 3{\cdot}5} = 3{,}235$ revolutions. You see I have surmised for the 26 in. pulley to drive a 9 in., which is fixed upon a counter-shaft with a 28 in., which drives the polishing spindle. Again (2) $\frac{140 \times 26 \times 30}{10 \times 3.5} = 3{,}120$; or (3) $\frac{140 \times 26 \times 28}{8 \times 3{\cdot}5} = 3{,}640$; or (4) $\frac{140 \times 26 \times 32}{10 \times 3{\cdot}5} = 3{,}328$. Thus you can vary the pulleys and speed in any way you require. If two counter-shafts are wanted (but in your case it would not be advisable on account of the friction) add another driving and driven pulley, and alter sizes to suit. To find size of any particular pulley, or speed of driving or driven shafts in any train of pulleys.—For example, take (2) above, when speed of driven is given at 3,120 revolutions. The equation stands as follows—

$$140 \times 26 \times 30 = 10 \times 3{\cdot}5 \times 3{,}120.$$

Suppose the speed of driving shaft is wanted, then $\frac{3{,}120 \times 10 \times 3{\cdot}5}{26 \times 30} = 140$. Or that a pulley is wanted on the driving shaft, then $\frac{3{,}120 \times 10 \times 3{\cdot}5}{140 \times 30} = 26$. Or a driven pulley is wanted on the counter-shaft, then—$\frac{140 \times 26 \times 30}{3{\cdot}5 \times 3{,}120} = 10$. Thus the figures can be changed about to find any required size or revolution. It would be advisable to drive on to the counter-shaft with a crossed belt. If this is not clear to you, write again, giving particulars as to position of shaft, room for counter-shaft, and polishing spindle.—BRASS.

Flow of Water through Syphons.—NERO.—The flow of water through syphons, you refer to, is a case that is covered by the formulæ for the flow of water through pipes wherein friction has to be considered. The gravitating force varies as the head of water divided by the length of pipe. The head of water in your case is the difference of level between the water surface in the cistern and the outlet of the syphon. Let h=head in feet and l= length of piping in feet; then the accelerating force varies as $\frac{h}{l}$

The frictional resistances vary, 1st, as the square of the velocity of flow in feet per second ($= v^2$), as twice the number of molecules pass over the surface of the pipe twice as quickly if the velocity be doubled. 2nd, the friction will vary as the circumference (c) of the pipe, and inversely as the sectional area of the pipe—that is, as the weight of water passing. Let s=area of pipe in square feet, and c, a constant to be determined by experiment; then the resistances,

$$= v^2 \times \frac{c}{s} \times c$$

As accelerating and retarding forces must be equal when uniform velocity is established, it follows that

$$\frac{h}{l} = v^2 \times \frac{c}{s} \times c$$

and,

$$v^2 = \frac{h}{l} \times \frac{s}{c} \times \frac{1}{c}$$

Let d= diameter of pipe in feet, then

$$\frac{s}{c} = \frac{d^2 \times 0{\cdot}7854}{d \times 3{\cdot}1416} = \frac{d}{4}$$

Replacing $\frac{s}{c}$ in the foregoing equation, we have

$v^2 = \frac{h}{l} \times \frac{d}{4} \times \frac{1}{c}$; c has been found by experiment to be = 0·0001. Therefore,

$$v^2 = \frac{2500\ h\ d}{l} \text{ and } v = 50\sqrt{\frac{h\ d}{l}}\ (a).$$

To find the gallons discharged per *minute*.—Let Q=gallons per minute, then (as one cubic foot=6·25 gallons)

$$Q = v \times s \times 60 \times 6{\cdot}25$$
$$= v \times 0{\cdot}7854 d^2 \times 60 \times 6{\cdot}25$$
$$= 294{\cdot}53\ v,\ d^2$$

Therefore $v = \frac{Q}{294{\cdot}53 d^2}$ replacing v in equation (a)

$$\frac{Q}{294{\cdot}53 d^2} = 50\sqrt{\frac{h\ d}{l}};\quad Q = 14{,}726\sqrt{\frac{h\ d^5}{l}}$$

I would mention that in using the formula $8\sqrt{h} = v$, you should qualify it by a co-efficient, which depends upon the form of adjutage it flows through. This is given in good note-books, and in treatises on hydraulics for various proportions.—F. C.

Stationery Holder.—E. M. (*Peterhead, N. B.*).—Your letter and one from another correspondent, asking simultaneously whether I would supply full-size working drawings of my stationery holder design (see supplement to No. 66, page 228), I must deal with together. I have, therefore, replied more fully to your brother reader, on page 504. Take one of the best pieces of advice that was ever given to me—"Keep your eyes open."—J. S.

Flexible Glass.—F. C. J. (*Masborough*).—I am afraid you will not get any flexible glass so large as you want it, but you could try writing to Messrs. J. Powell & Sons, Whitefriars Glass Works, Temple Street, London. Explain clearly what you want it for, and the exact size, and they would give you an idea if it could be obtained; they are a very good firm to deal with for all sorts of glass, and I have found do not mind selling amateurs small quantities.—W. E. D., JUN.

Silvering Glass.—C. H. G. (*Liverpool*).—To silver glass for a mirror, procure as perfect a piece of glass as possible; clean thoroughly (merely rubbing it up will not do, as the smallest speck will show only too plainly when finished); get a piece of tinfoil a little larger all round than the glass. Cover the tinfoil with mercury (quicksilver), and lay a piece of clean white paper on, and the glass upon that, then with a quick motion, holding the glass firmly, draw the paper from underneath, leaving the glass upon the tinfoil; weight it down, so as to squeeze as much of the mercury out as possible, and leave for a little time. Finally rear it against a wall, so that all the mercury possible may drain out, and let it remain so for, say, a day or two, according to the state of the weather. Do not attempt to silver large pieces. Amateurs without experience or proper appliances and places

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cannot hope to do it either so well or so cheaply as manufacturers, but with very small work you will be able to succeed, with care. I do not in the least wish to discourage you, as I know the pleasure of doing every part of the work yourself, but do not aim too high at first.—W. E. D., JUN.

Jensen Electric Bell.—E. T. (*London, N.E.*).—The "rough sketch" originally made of this bell in reply to C. D. (*Rochester*), has been made into a finished picture by the Art Department of Messrs. Cassell & Co. Hence the picture of the interior of this bell, as given on page 227, Vol. II. of WORK, is very clear, and should mislead no one wishing to fit up a bell of this pattern. There may, however, be a few details of this picture, which will be more clearly understood by a few words of explanation. Above and below the bobbin carrying the coil of wire, but close to its ends as if clipped between them, you will see two white patches: these represent two pieces of soft iron, into which the soft iron core C fits tightly. They may be regarded as the pole pieces of the electro-magnet, and are magnetised equally with the core when the current passes through the coil of wire. The piece of soft iron which forms the coil also serves the purpose of a support to all the interior works of the bell. The upper part of it is therefore turned to pass through the top of the bell, and screwed to receive a holding-up nut, which also forms one of the terminal binding screws. To prevent this part of the core from coming into contact with the metal of the bell, it is insulated therefrom by means of a sleeve or tube of ebonite or boxwood, as shown in the engraving. At A D is also shown in section an ebonite disc or washer, which insulates the lower part of the core from the gong, and also serves as a support to the contact spring. In the engraving, this spring is shown as touching the core; it must not touch the core, but must be fixed by small screws to the insulating washer. The armature, and also the shank of the hammer, are fixed to a loose oval sleeve on the core, and this sleeve is hung on a brass pivot passing through the core. I have complied with your request, and have sent detailed instructions and illustrations showing how to make the fittings for such a bell as you require.—G. E. B.

Parquet Flooring.—A. A. (*Lincoln*).—You will find that ordinary glue will suit your purpose very well, providing the floor underneath is fairly flat, and free from large cracks and projecting knots. Do not be under any apprehension as to nailing, but use what are known as panel pins; about 1 in. long will suit the thickness of stuff you mention. Likewise, do not fail to put in sufficient, for a little beeswax will effectually stop the holes, and when the whole is waxed or polished will not show at all. I may say, by the way, that panel pins are similar to French nails, with the exception that they are thinner and the heads are very much smaller and countersunk.—E. D.

Book on Surveying.—A. H. (*Manchester*).—You should get Merrett's "Practical Treatise on Surveying," price 12s. 6d., published by Spon & Co., 125, Strand, London.—K.

Black for China Painting.—G. R. (*London*) is impatient. G. R. asked the question three weeks ago, and complains it is not yet answered! I did answer it, enclosing diagrams, which required to be drawn and engraved and then wait for their turn in our crowded "Shop," and ere this appears he will have seen it. More than this it would be scarcely fair to expect.—J. W. H.

Cork-cutting Machine.—AB UNO DISCE OMNES, whose very apt quotation as a *nom de plume* I hereby beg my Editor to adopt as the motto for "Shop," and thus stereotype it for ever, desires to know who can supply him with a machine that will cut cork into strips, stating that such a machine exists on the Continent. I rather think that in my wanderings years ago in the Faubourg St. Antoine, in Paris, I have seen a sort of drawknife bread-cutting machine used for this purpose. I am, however, not quite clear as to the locality—it might have been in America or even in the "East" (of London). However, if a tool be wanted for any purpose, my conviction is that that tool can be made or found ready-made, so we will consider what it has to do. Cork is like indiarubber—susceptible of being cut only one way, namely, by a drawing cut; not by a direct sharp cut, like wood. Hence a diagonal guillotine paper-cutting machine, such as Salmon's, The Parsonage, Manchester, would be most likely to answer the purpose. The knife, like a cork-cutter's or shoemaker's knife, does not require to be a razor-edged tool, but rather a scythe-edged tool; the edge when viewed through a microscope showing serrations like fine saw-teeth, rather than an edge produced by finely rubbing on an oilstone, all the grinding scratches out of it. If AB UNO DISCE OMNES will ask some local printer or stationer to try cork under such a paper-cutting machine, he will see if it answers, and perhaps pick up from some printers' broker one of a size to cut strips up to even 60 in. long. A double demy machine cuts 37 in. across. James Salmon, Printers' Broker and Engineer, St. Mary's Parsonage, Manchester, would no doubt give our correspondent the best information on the subject.—J. W. H.

Rubber Shoes for Crutches.—A. S. (*Musselburgh*) writes for the address of Messrs. Macintosh and Co., Limited, Indiarubber Manufacturers, Cambridge Street, Manchester. I do not know if they still make these useful articles, but no doubt they would make them to order, as they did thirty years ago for me. Any rubber manufacturer, however, is at liberty to make them, as they are not patented or protected in any way. A. S.'s letter has been sent on.—J. W. H.

Wood-carving Patterns.—W. J. H. (*Redhill*).—First-class patterns for wood carving are very difficult to obtain; though there are many published, they are as a rule very inferior as designs. I think the best way is to get good photographs or prints of old or good modern work, and adapt it to your own purposes; these may be obtained from Batsford & Co., 52, High Holborn; they have, amongst other things, a portfolio of photographs of Professor Frullins's carvings, which are very beautiful and full of suggestions. Mr. Sutton's new publications of photographs from the carved work in the South Kensington Museum, sold in folios of eighteen plates, 13s. post free, with descriptive letterpress, or in single sheets, 9d. each, are first-rate, and are to be had at the School of Wood Carving, South Kensington. Two books, one by W. Bliss Sanders, entitled "Carved Woodwork of the Sixteenth and Seventeenth Centuries," and the other by A. Marshall, "Specimens of Antique Carved Furniture and Woodwork," will also be found very useful.—M. E. R.

Design for Chapel and Class-room.—H. W. (*Lancaster*).—In compliance with your request I herewith send you a design for a chapel with class-

Design for Chapel and Class-room.

room as requested for insertion in "Shop" of WORK. The estimated cost will be about £150, and the place will seat 100 persons comfortably.—W. B.

Engineers' Tools.—ENGINEER.—I do not know of any book up to date embracing modern practice in these tools. The best information is to be obtained in the workshops, but useful papers appear from time to time in the technical journals, and I should advise you to read these. If the Editor is willing to spare space, I will give a couple of papers on these subjects.—J.

Castings.—DELPH.—Unless your patterns are made well and mouldable, no founder will look at them. In any case, it is almost a favour to get very small castings made. Try Lee, High Holborn, or Lucas & Davies, Hatton Garden, London, E.C.—J.

Stationery Holder Design.—J. B. (*Darlington*).—Pleasure is experienced by me at the complimentary reception of my Stationery Holder design (Vol. II., No. 66, supplement). Yours is not the first communication I have received, requesting me to forward full-sized drawings of the same. This I shall be very glad to do, and, with the Editor's permission, I will prepare you a set as soon as business will permit.—J. S.

Book on Dynamo.—W. C. (*Manchester*).—I have been favoured by Mr. Bottone with a copy of the sixth edition of his book, "The Dynamo: How Made and Used." In this edition there is a useful addenda of twenty-four pages, describing the winding of other armatures besides that of the H girder form, and giving rules for calculating the output of dynamos. The addenda is illustrated with twenty-one additional illustrations of such machines as the Gramme, Manchester, Simplex, and Alliance dynamos, and their various parts. The book may be obtained direct from the author, Mr. Bottone, Electrician, Carshalton, Surrey, by post, for 2s. 6d.—G. E. B.

Lantern Stands.—MAGIC asks for the names of one or two places where he can get "stands for magic lanterns." As I am not aware that any special stands are designed for this purpose, I must "give it up." It is possible that MAGIC has not expressed himself as clearly as he imagined. All parts and appliances used with the lantern may be obtained of the makers, whose name is legion, and their addresses may be found advertised in a hundred magazines. In the meanwhile, apply to Mr. Lancaster, Colemore Row, Birmingham. If anyone can meet your want, I think he can.—O. B.

Whetting Graver.—J. L. (*Wigan*) sends me a graver to be whetted. The graver, I am sorry to say, was received broken, so as to be completely useless to anyone. I have, however, supplied another, one of Seller's best, of about the same length, but much stouter than the one sent, which is much too light for a beginner, who, generally speaking, is not very delicate in his first attempts at engraving. You will see that I have made the facets on the *belly* of the graver very long, so that the graver will last you a good while, and all you have to do when the graver becomes dull is to sharpen it on the *back*. I have only to wish you every success.—N. M.

Bicycles.—ONE WHO WOULD LIKE TO KNOW.—I would like to know what would make the bright parts of bicycles shine like silver plate, as I know of nothing that will do it except silver or nickel plating. It is possible to give steel a high polish looking as shiny as plating by bestowing much labour on it, but the shine will not remain, as the moisture of the atmosphere dims it immediately. [Bright polished steel may be protected against the atmosphere by coating it, when newly brightened, with "Silico Transparent Enamel." To be had from the Silico Enamel Company, 97, Hampstead Road, London, N.W.—A. S. P.]

Walking-stick Gun.—ZERO.—Walking-stick guns vary considerably in their make and the distances they will carry a charge effectively. Some are simply a breech chamber and a brass lining for tube to carry a shot or pellet, the whole encased in malacca cane, with a buck-horn handle, weighing about a pound and a quarter; the calibre is 7 M, or about ¼-in. pellet; penetration, a ¼-in. pine board at thirty or forty feet; the price about 28s.; ammunition, 5s. per hundred. They may be bought of Bland & Co., Strand. A more efficient weapon is made, walking-stick shape and finish, with hook handle, made to receive a proper gunstock screwed into the handle hook. The stick is solid gun-barrel, breech-loading, and takes special ammunition, about ⅜ in. diameter, either ball or shot; will kill rabbits or rooks at 60 yds. Price complete, 45s.; ammunition, about 8s. per hundred. The old muzzle-loading walking-stick gun, requiring a ramrod, is not now made. Air-guns have much less force of penetration, and are useful for practising aiming and shooting at a mark. They may be bought at novelty shops in most large towns from 5s. 6d. up to 42s. Requiring an air-chamber in the stock, they are not made as walking-stick guns generally, though some are to be bought. A combined air or powder charge gun is made and sold for 38s. by Richford & Co., 149, Fleet Street, London. The best walking-stick guns are by Cogswell and Harrison, 226, Strand, London. Any of the firms named will send their circulars and illustrated price lists to you on application. Any further information required will be gladly given.—J. C. K.

Obtaining a Patent.—A DELUDED INVENTOR.—Burnt children, it is said, dread the fire, and this is true generally, but not always, for many who have been burnt, whether physically or in pocket, foolishly try again, only to come second-best off once more. You, however, are among the wiser ones who are content with one scorching, and, more than this, you wish to render your experience a source of benefit to others. If you can possibly avoid doing so, it is better not to stir up muddy water, and therefore I do not publish your letter *in extenso*, but merely the commencement of it, in which you say:—"Will you allow me to give a few words of advice to your correspondent X. W. (*Crowle*) respecting his desire to obtain a patent for his invention. I would advise him, first, to get a copy of the Patents Act, costing 2s.; study it a little, and he will then be able to draw up his own specification on forms to be got at any post office without the aid of"—and here I had better drop your own words, and simply substitute—"the middleman." I cordially and completely agree with you in all you say, but the comic papers teach us that there are things which it were better to have left unsaid, and, *pari passu*, unprinted. Let the middleman "imagine it," as the song runs.—ED.

Home-Made Lathe.—J. R. D. (*London, N.*).—You wish to know how to make a lathe to suit the "overhead" described in WORK, No. 75. Now this is like asking how to build a house to suit some chimneys, or how to make a locomotive to suit a funnel which has taken your fancy; surely you must hail from the antipodes or some other upside-down country. No, no, friend, don't put the cart before the horse, nor expect to be told how to make a lathe in a few lines. If you watch the columns of WORK you will by degrees get the information you

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want. Whole pages would be required to teach a beginner how to make the simplest kind of lathe. You will get it all in good time; but begin with the lathe, not the "overhead;" when you have used a lathe for a year or two, and can do plain turning, then it will be time enough to make an "overhead" to suit your lathe, and not a lathe to suit an "overhead."—F. A. M.

Polish to Shells.—A. W. B. (*Swansea*).—You do not say what shells you wish to polish, or I should have known better how to advise you; but shells as a general rule are not polished, and if it is to bring out the markings as you see them when wet, you will find that gum-water, or white of an egg, brushed over will do this; or as it is for fancy work which will be handled, you might use varnish; if, however, you would rather try to polish them, scrape or file them, then rub down with emery paper, and finish with rotten-stone or tripoli; but if the shells are very small, I do not think it will repay you for your trouble. Many shells which look very plain at first may be greatly improved by steeping in warm water, and then scrubbing with a brush; this removes a thin coating, and brings out the markings which are underneath.—W. E. D., JUN.

Blocking.—NEMO.—If NEMO knows anything about blocking he will have no difficulty in working his Mackay. If it is heated with gas it is used in the ordinary way, same as any other blocking press: the type is set up and tightened in the forme and fastened to the little plate with the handle, the work is laid on to the gauges, the forme is drawn out, and the gold or silver laid on the top of type; the forme is placed in again, the lever at the side is brought down and raised, the work taken out, and the letters or design will be blocked upon it. Care must be taken not to have too much pressure or too much heat. I cannot give the maker's instructions; but if NEMO has the address, which will be on the brass plate of the machine, he can easily write and procure them. I hope this will be of value to our friend.—G. C.

Lenses.—TRIPOD.—Good work may be done with almost any double convex lens, provided the user knows how to do it. A quick-working lens must work with good definition and a large opening. This has been a problem for skilled opticians from the beginning. Much depends on the quality and refractive power of the glass; B and D in the diagram sent would be most likely to work satisfactorily; but as to rapidity, testing them could only find out; A would be useless for the purpose. The curves of the lens are the principal factors in the effects obtained by them. The greater the curve the shorter the focus, and, generally speaking, so is the rapidity: but rapidity is regulated by the amount of light passing through the lens, and the form of the lens is designed to give the largest amount of light with the best definition over a surface of determined size. The diaphragms have considerable influence on the image; the smaller the aperture the better the definition. Their position with respect to the lens is very important, causing or reducing distortion of the image. I should advise TRIPOD to get some handbook on photographic optics and study that.—D.

Negative Developing.—W. R. O.—Merely pour the developer over the negative in a dish, using sufficient solution to cover the plate perfectly, and keep it in motion by rocking the dish until it is sufficiently dense. Remove and wash under the tap and place in fixing solution, made of one ounce of hyposulphite of soda to five ounces of water. Well wash, and place in the alum solution for a few minutes, then wash for a few hours in frequently changed water, and dry. Always use the alum after fixing.—D.

Telephone.—MICROPHONE.—You will have some little difficulty in procuring telephone transmitters, as the apparatus is generally sold in sets. However, you can easily make a pair from the instructions given in WORK. I am sorry that I have not my back numbers beside me at present, so I cannot tell you which to look at; but almost every week from No. 28 you will find something. If you want any special form of transmitter, write again, and I will try and help you.—W. D.

Gesso Work.—A. R. B. (*Dublin*).—To employ a mould for gesso work would be to reduce the art to a mere mechanical process. You can only trust to your eye to keep the height of the design regular. A slight difference in the repeat is never undesirable, since it shows the work is done by hand. Practice will soon help you to make the repeats sufficiently accurate to be artistic.—C.

Camera.—G. D. P. (*Aberdeen*).—If the enlargement is to cover the whole space, the 8 in. R. R. lens is the most suitable for the purpose. If only the centre of the space is to be filled, as in a portrait head, for example, the ½-plate portrait lens may be used. The best lens for the purpose is a 5 in. rapid rectilinear, as the longer the focus of the lens the greater must be the extension of the camera. With very wide angle lens, the nearness to the picture to be copied is a drawback.—D.

Waterproofing.—J. R. (*Newton*).—There is no such article as you require in the market at present; all the materials now used for the purpose are quite unable to fulfil your requirements, and possess so many objectionable features that we should not recommend you to try them for what you propose, as we are sure the only result would be failure, with injury to or destruction of the article to which they are applied. We have lately seen just the thing that will suit you for all you want, but as it is at present under severe tests—all of which it has so far passed satisfactorily—arrangements are not yet completed for bringing it on the market. One great thing we particularly noticed—its perfect freedom from any unpleasant or other odour—should recommend it; whilst its freedom from cracking and peeling off, or injuring what it is applied to, are not the least of its advantages.—C. E.

Table Roller Lever Escapement.—TIME.—Put your plates together with the train in—that is, fusee, centre wheel, third wheel, fourth wheel, 'scape wheel, and pallets; leave the barrel out and chain off; cut a thin and narrow wedge of cork and place between the lever and top plate; put your maintaining power on and gently move the lever (pallets) till the 'scape wheel drops off one pallet on to the other; the distance up the locking faces the tooth should drop is just the thickness of the tops of 'scape teeth; it should then have the same amount of run after before touching the banking pins, which will allow the guard pin to free the roller; and also make sure of the teeth falling in the case of some being slightly longer than others, or the wheel being out of truth, so if you allow freedom of about the thickness of tissue paper between the

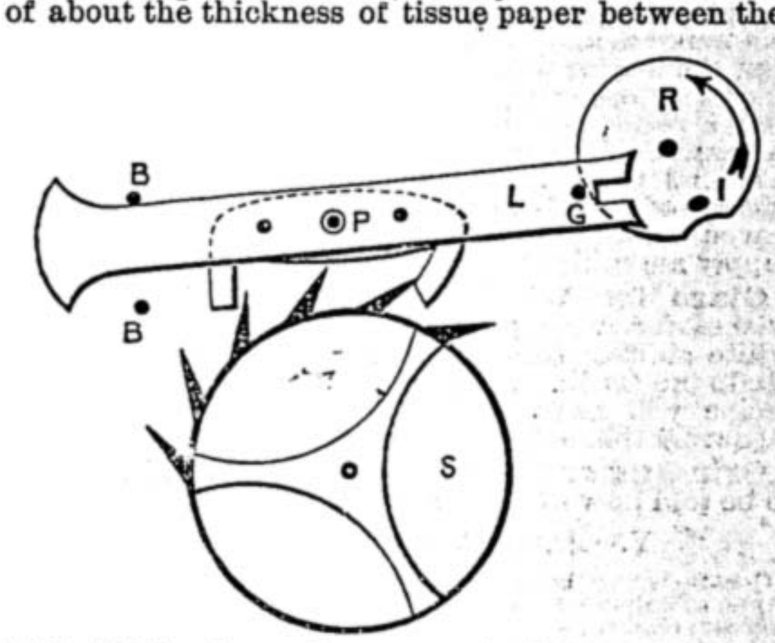

Table Roller Lever Escapement—L, Lever; P, Pallets; B, Banking Pins; G, Guard Pin; I, Impulse Pin; R, Roller; S, 'Scape Wheel.

banking pins and the sides of the lever after the 'scape teeth have fallen from one pallet to the other, also the same amount of freedom between the guard pin and the roller, when the lever is resting against the guard pins, I think you will be safe. The proper depth for the impulse pin is so that it shall be fair in the lever notch; it must not touch the bottom of the notch or you will get no vibration, and in positions will stop, and you must see that it does not butt against the corners going in and out; also see that all your holes of the 'scape wheel, pallets, and staff are well fitting; if at all wide put new ones; if brass ones, well burnish them to make them hard, and where jewel ones put new. See that your hairspring is properly in circle, and quite flat, and free everywhere. See that your pivots come well through the holes, and where endstones, see that they rest on them; round up the pivots' ends nicely, and if the endstones are marked put new ones.—A. B. C.

Bookbinding.—J. C. (*Birmingham*).—Surely this correspondent has only started to take in our paper. I cannot think that he has had it for any time, for the information which he seeks concerning bookbinding has been given again and again. He has also been guilty of a slight act of indiscretion, inasmuch as he has not confined one question to one piece of paper. He will please note that questions on different subjects should be written on separate pieces of paper. However, the Editor has marked the portion with red ink which he wants me to notice, so I will proceed. You want to know how to fasten your numbers of WORK together for binding, the best way to do this, and the tool required for the purpose. Well, now, really this does look a childish question, and I am very near feeling that you are poking fun at us. The tool required is simply a needle. And the best method is simply to take the volume and knock it up straight and saw five grooves upon the back at equal distances from each other and the two outer edges; this done, if you have not a sewing-bench, or have not seen the dodge described by a correspondent a few weeks ago, tie three cords to the top and bottom rails of one of the kitchen chairs in such a position as will suit the three centre grooves in the centre of the back of the book. Now take up one number and lay it down upon the bottom of the chair or bench with the back up to the cords, and put the needle with a thread in it in at the bottom, and bring it out at the top side of first band, put it in at the under side of the same, bring it out at the top side of the second, put it in at the under side, carry it to the upper band, and then out at the top; take another number and go down this one, sewing until you come to the bottom; fasten up, and go on in the same way until the whole book is sewn. You might look up your back numbers for more information. I have not mine beside me at present, and so cannot assist you in the search.—G. C.

Iron Roofing.—A. S. (*Ayrshire*).—The iron you require for roofing purposes is quite a different thing from the common sheet iron mentioned in my article; this is mostly used for stove piping, buckets, skeps, scuttles, etc. What you want is called galvanised corrugated iron; the gauge you speak about—viz., No. 13—is far too thick: 18 gauge would make a very strong roof, but there would only be about four or five sheets to the cwt., and not so many as that if they were 9 or 10 ft. sheets. If your house is, as you say, a small one, I should advise you to use 22 gauge; you will find that plenty heavy enough—in fact, we sell more of that and 24 gauge than any other thickness. With regard to how many yards there are in a cwt., that, of course, depends on the thickness, but, taking 22 as an example, you would get about 16 sheets per cwt., covering 6 ft. by 2 ft.; in reality they are 2 ft. 3 in. wide, but as 3 in. go for lap, they only cover 2 ft. in width, so 3 sheets would cover 4 square yards, so you can easily calculate how many cwt. you would want. The length of the sheets will depend on your roof; supposing it is 6 ft. 6 in. from ridge to eave, you would want to get sheets of 7 ft. long and cut a trifle off the ends, as you would not require it to overhang 6 in.; supposing your roof 11 ft., then use two 6-ft. sheets, giving about 9 in. lap. In this case you would want a purlin half way up the roof to fix the first row of sheets to. Now as to price and where to buy. Messrs. Daws, Brothers, & Co., Limited, Crown Works, Wolverhampton, supply at the following rates:—16, 18, and 20 gauge, 5 to 8 ft. long, £10 10s. per ton; 22 gauge, £11 5s. per ton; 24 gauge, £11 10s. per ton, net, at the works; carriage to buyer's station extra. Black corrugated sheets for painting, about £3 per ton less. Messrs. Hill & Smith, Twidale, Tipton, Staffordshire, supply 5 to 8 ft. sheets, 22 gauge, £13 per ton, with 20 per cent. off. This firm also supply a patent self-adjusting sheet, requiring no riveting or fixing at the sides, for which they claim many advantages; they are, however, considerably higher in price. I am unable to say if these firms would supply a cwt. or two, but I should think they would, or, at any rate, a quarter of a ton. Messrs. Hill & Smith have an office at 73, Elmbank Street, Glasgow, but I do not think they keep stock there. I shall be pleased to give any further information required.—R. A.

Perspective.—STUDENT wishes to know—"Is there any method of determining by the relative size of a sketch with the actual size of the object the distance I am from the object? If so, what is the rate of decrease in any given space, say 10 or 100 yards?" In other words, this amounts to the query, "Can perspective drawings be done to scale?" No; and for this reason: that the apparent decrease in size of every object as it recedes from the eye is not at the same rate at any two different equal parts of that distance, but is in the inverse ratio of the squares of the distances. Again, the size a distant object appears to one eye, is not the same it would appear to another eye at the same distance from it; just as two cameras at any point photographing the same object at same distance would give pictures in correct perspective but of different sizes; this is because the lenses through which the rays of light pass are reflected at different angles; and so it is with the eye, which is a lens itself. All that perspective can do is this: it can determine with minute exactness the relative sizes of objects in the same picture according to their relative distances from the eye, by construction geometrically from the plan and elevation drawn to scale. In other words, just as one can draw to scale an object maintaining the same proportion between every dimension, whether that scale be $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{100}$, or $\frac{1}{1000}$ of the full size; so by using the plan and elevation in our construction of the perspective, those dimensions will be preserved in true perspective proportion. But as they diminish in different ratios, you cannot measure them in the perspective drawing as you can in plan and elevation with your scale. Another point which I have never seen alluded to in books on perspective, and which should be clearly and distinctly borne in mind, is that all perspective drawings are *one eye* pictures. In natural vision, one eye sees further round one side of an object whilst the other sees further round the opposite side of the same object, which is the reason of that effect of rotundity which one sees in nature and not in perspective drawings. The stereoscope presents two pictures at the same time, and when they blend—one being a right-eye view and the other a left-eye view—their combined effect is that of natural vision, and rotundity is the result. Therefore, in sketching from nature, close always one and the same eye when viewing and comparing objects in different planes—never look with both at your view—and keep your eye as nearly as possible in one spot. In measuring with a pencil perspective distances (which you allude to as your method and I disapprove of as almost impracticable, because it is almost impossible always to keep the pencil one exact distance from the eye), you will find that after measuring one apparent dimension you will never be able, however you try, to get it exactly the same again, and you should therefore discard it as not accurate enough. Your eye can be trained by practice to compare lengths and heights, etc., far more accurately than by such methods, which, indeed, if relied upon at all, will retard the education of the eye instead of assisting it. Space in "Shop" being too limited to permit of my going thoroughly into the wide subject of perspective, I can only recommend you to obtain Weale's manual on the subject (Lockwood & Co.), by G. Pyne, 2s., by order from any bookseller, and with the above hints you will find it a delightful study. I may add, that whilst

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apparently very complicated, it is as simple as A B C, if you clearly fix in your mind the true meaning of the terms used, and never confuse the actual and real with the representation of them you are producing. As an instance, the picture plane—an imaginary surface between your eye and the view itself—may be anywhere between. You have to imagine the points at which the various rays of light passing from the objects to your eye cut this picture plane—if you are merely sketching—and you must never allow yourself to regard this imaginary plane as the picture you are making. You are simply copying on your picture a reduced view, to any proportion you like, of what would appear on this imaginary plane. Perspective teaches you how to project with unerring accuracy on to such a plane these points of intersection.—J. W. H.

Polishing.—AMATEUR.—Yes; treat the wood as if it were mahogany.—D. D.

Furniture Wood.—OXGALL.—Unless you can give the name of the process, it is impossible to say how the decorations you ask about were done. There are several methods of imitating marquetry work, many of them the subjects of patents, but none that I have seen are to be compared with the real thing.—D. D.

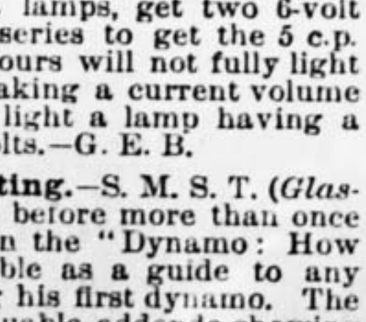
Oak Carving. — A. C. L. B. (*Norwich*).—You can darken new oak carvings either by fumigating—that is, subjecting them to strong ammonia vapour—or by staining them with any of the ordinary liquid stains. The former method is to be preferred, as the grain of the wood is not raised, but everything depends on the colour you want.—D. D.

Leclanchè Battery for Electric Lights.—G. A. B. (*Sunningdale*).—(1) A Leclanchè battery of four cells, each 5 in. by 4½ in. by 2 in., specially fitted with flat carbon plates and large bent plates of zinc, will light up a 2½ c.p. 5-volt lamp for ten minutes at a time and yield current for twelve months with little or no attention. These will cost about 5s. per cell. The lamp will cost 4s. 6d. The Gassner is superior in point of cleanliness, portability, and constancy. It would require no attention whatever for two years if used for ten minutes or a quarter of an hour morning and evening. (2) There would be no appreciable difference in the light if used at the ends of a line of No. 18 wire, 3 yards from the battery. (3) The two samples of wire sent are: Large size, ·083, equal to No. 14 B.W.G.; small size, ·064, equal to No. 16 Standard Wire Gauge, or about the same in B.W.G. I have communicated your questions to D. O. W. (*Ipswich*) as you desired, and will let you have his reply when I get it.—G. E. B.

Battery for Electric Light.—W. C. (*Hulme*).—Your battery of six cells, each furnished with a zinc plate 4½ in. by 1¾ in., enclosed between two carbon plates of the same dimensions, should, when charged with chromic acid solution (composed of three of chromic acid dissolved in each pint of water and acidulated with three of sulphuric acid to each pint of solution) and arranged in series, light up a 5 c.p. 12-volt lamp for half an hour at a time. One charge will furnish light for six half hours. If you use 2½ c.p. lamps, get two 6-volt lamps and place them in series to get the 5 c.p. light. Such a battery as yours will not fully light a lamp of low resistance taking a current volume of 3 ampères, nor will it light a lamp having a higher resistance than 12 volts.—G. E. B.

Book on Electric Lighting.—S. M. S. T. (*Glasgow*).—I think I have said before more than once that Mr. Bottone's book on the "Dynamo: How Made and Used," is suitable as a guide to any student or amateur making his first dynamo. The latest edition contains a valuable addenda showing how to wind several different types of machines. It may be obtained of the author (who lives at Wallington, Surrey) by post for a 2s. 6d. postal order. If you wish to study electric lighting, you may find the following books of some use to you:—"Arc and Glow Lamps," by J. Maier, price 7s. 6d.; and "Management of Accumulators," latest edition, by Sir D. Salomons, price 5s.: both published by Whittaker & Co., London. If you want something more costly, get "Electric Lighting," by J. E. H. Gordon, price 18s., published by Sampson Low & Co.; or "Electric Illumination," two vols., at 30s., published at the *Engineering* office, 35 and 36, Bedford Street, Strand, London. If you find any difficulty in getting books, I will try to get them for you, if you write and enclose your address.—G. E. B.

Connecting Coils of Machine.—GOOD OLD JEFF.—Suppose the commutator of the machine to be spread out on a plane surface and part of it represented as shown in the annexed figure. Coil 1, on the first ring of the armature, will have its commencing end connected to the bar F, and its finish end connected to the commencing end of coil 2, which will then be connected to bar E, and so on until all the ends of each coil on the five rings have been connected to all the bars. Follow on with each set of coils in this way, until one end of each coil has been connected to each bar of the commutator, and the remaining ends soldered to the leading wires as shown in the figure.—G. E. B.



Polish. — S. S. (*Salford*). — Mahogany may be darkened either by fumigation with ammonia or by staining. For obvious reasons, the former method is generally adopted in the kind of furniture to which you allude.—D. D.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Picture-frame Moulding. — H. R. (*Bacup*) writes:—"Can any reader of WORK tell me where I can get picture-frame moulding, etc., in Manchester?"

Hot-water Engineering. — L. S. (*London, S.E.*) writes:—"I shall be very pleased to be informed of any class or classes held in London in the evening, in which hot-water engineering is taught. I have some knowledge of the work, but want to get a theoretical, as well as practical, knowledge of it."

Telephone District and Sections.—INQUIRER writes:—"I shall feel obliged to any reader for an opinion as to my position. I have a district two miles by one mile, and I wish a section in the centre, and ten other sections surrounding this centre section to be in telephonic connection with this latter. I have been in communication with some firm to make me such a plant: some say they can make it, and guarentee me free from any claims that the National Telephone Company might make upon me; other firms say that they cannot make me such a plant, neither can any other firm make it to give satisfaction and free me from the claims of this National Company. I would like to know the opinion of our readers or yourself, and, if agreeable, I would like the address of some good firms to supply me with such a plant."

Glaze for White Shirts. — NED (*Lynmouth*) wishes for a recipe for making glaze for glazing white shirts. He has tried several mixtures, but all to no avail. Anyone who will send a good recipe will have the love of all the laundresses. —[Surely this ought to be an inducement.—ED.]

Grinding and Setting Razor.—X. Y. Z. wishes to be told how to grind and set a razor.

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—R. R. G. (*St. Peter's Park, W.*); R. W. (*London, S.E.*); AMATEUR; S. D. (*Brixton*); CUPBOARD; E. P. J. (*East Dulwich*); A. W. S.; H. E. C. (*London, S.W.*); A. E. S. (*Islington*); A READER FROM THE FIRST; R. R. (*Walsall*); APPRECIATIVE READER; BREVITY; J. D. (*Manchester*); J. R. (*Watford*); MARKWELL; J. F. M. (*Wolverhampton*); N. A. P. (*Hackney*); J. M. (*Edinburgh*); J. L. (*Wimborne*); A. W. L. (*Bilston*); J. P. S. (*Hertford*); P. A. D. (*Canonbury*); W. H. (*West Kilburn*); F. W. (*Birmingham*); H. S. (*Walworth*); C. E. M. (*Devonport*); G. W. (*Lancaster*); A. L.; J. S. (*Blackburn*); E. S. (*Aldershot*); H. H. (*Rochdale*); J. P. (*Peckham*); F. S. S. (*Enfield*); F. S. (*Clapton*); S. E. (*Camberwell*); W. E. H. (*London, W.C.*); S. J. S. (*Frome*); H. P. (*London, W.C.*); R. H. B. (*Hants*); E. T. (*Bolton*); A. A. (*Hawkesbury*); H. G. (*Lancashire*); R. F. S. (*Sunderland*); E. S. (*Huddersfield*); W. D. (*Newcastle-on-Tyne*); ARGENT; E. C. M. (*Ipswich*); E. H. (*Manchester*); E. R. T. (*Egremont*); W. S. (*London, S.E.*); J. G. (*Wilts*); W. J. W. (*West Bromwich*); A. S. B. (*Midlothian*); A. A. S. (*Leeds*); BLACKBIRD; M. T. W. (*Warbleton*); T. E. G. (*Redhill*); H. G. (*Dulwich*); MECHANIC; R. W. R. (*Ambleside*); A. M. A. (*Bradford*); F. W. B. (*Derby*); J. S. W. (*Kendal*); S. F. (*Surrey*); J. G. (*Manchester*); D. L. (*Blairgowrie*); H. T. (*Huddersfield*); W. C.; F. S. M. (*Huddersfield*); M. N. W. (*Wells*); S. R. (*Newry*); J. M. T. (*Hylands, Australia*); AMBIGITUR; L. A. M. C. (*Ipswich*); S. D. (*Lifford*); A. V. (*Northampton*); R. R. (*Belfast*); E. G. C. (*Stockport*); G. A. (*Pembroke Dock*); H. S. (*Regent's Park, N.W.*); WORKING JOINER; T. G. (*Uttoxeter*); G. B. (*Stoke-upon-Trent*).

IMPORTANT TO INVENTORS AND DESIGNERS.

"WORK" EXHIBITION.

THE Proprietors of WORK are gratified to be able to announce that under the PATENTS, DESIGNS, AND TRADE MARKS ACT, 1883, they have applied to, and been granted by, the Board of Trade, a CERTIFICATE, as required by the Act cited, that the WORK Exhibition is an Industrial Exhibition, as defined by the Act, and that therefore any exhibitor, on giving notice to the Registrar of Patents, Southampton Buildings, shall be entitled to protection for any design or invention which is not the subject, as yet, of any application for Provisional Protection or of any Registration of Design. The protection thus afforded will extend to the duration of the Exhibition and six months afterwards, its effect being that workmen and others may, without prejudice to their future claims for Registration of Design or for Letters Patent for Inventions, exhibit drawings or models, and thus bring them safely before capitalists, as the following extracts from the Act will show. Forms for notice and full information as to fees may be had from the Great Seal Office, Southampton Row, London, either on personal application or by enclosing stamped directed envelope by post.

PATENTS, DESIGNS, AND TRADE MARKS ACT, 1883.

Section 39.—The exhibition of an invention at an industrial or international exhibition, certified as such by the Board of Trade, or the publication of any description of the invention during the period of the holding of the exhibition, or the use of the invention for the purpose of the exhibition in the place where the exhibition is held, or the use of the invention during the period of the holding of the exhibition by any person elsewhere, without the privity or consent of the inventor, shall not prejudice the right of the inventor or his legal personal representative to apply for and obtain provisional protection and a patent in respect of the invention or the validity of any patent granted on the application, provided that both the following conditions are complied with, viz.:—

(*a*) The exhibitor must, before exhibiting the invention, give the comptroller the prescribed notice of his intention to do so; and

(*b*) The application for a patent must be made before or within six months from the date of the opening of the exhibition.

Section 57.—The exhibition at an industrial or international exhibition, certified as such by the Board of Trade, or the exhibition elsewhere during the period of the holding of the exhibition, without the privity or consent of the proprietor of a design, or of any article to which a design is applied, or the publication, during the holding of any such exhibition, of a description of a design, shall not prevent the design from being registered, or invalidate the registration thereof, provided that both the following conditions are complied with, viz.:—

(*a*) The exhibitor must, before exhibiting the design or article, or publishing a description of the design, give the comptroller the prescribed notice of his intention to do so; and

(*b*) The application for registration must be made before or within six months from the date of the opening of the exhibition.

I therefore give notice that the time specified for the receipt of applications for space, previously fixed for October 30th, will now be extended to November 15th, in order to enable inventors and designers to take advantage fully of this privilege.

JOHN WHITFIELD HARLAND, Secretary.

La Belle Sauvage,
Ludgate Hill, E C October, 1890.

WORK

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PURITY OF BLOOD ENSURES A GOOD COMPLEXION.

A GOOD COMPLEXION is an attraction every woman wishes to enjoy for herself.

This boon may be readily attained by all, save, perhaps, some of those who are the victims of hereditary Blood or Skin Disease.

To ensure a good complexion Nature's own processes must be followed.

Nature endeavours to throw impurities out of the blood, and to eject them from the kidneys and pores of the skin.

But, being heavily handicapped by the conditions of modern life, Nature cannot always succeed in doing this, and even when she can, the process is apt to be attended with breakings-out, rashes, and eruptions.

But Art working with Nature may, in the form of "Frazer's Sulphur Tablets," effect that which the former cannot do alone.

That is to say, the poisonous and irritant properties of the out-throw may be masked or covered by a purifying and curative power stronger than the evil forces at work.

Further assistance is also given by "Frazer's Sulphur Tablets" possessing a similar expulsive power to that possessed by Nature herself.

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"Frazer's Sulphur Tablets" follow Nature also in their preparation.

The Garden Rhubarb is one of the best natural Blood Purifiers, because it contains a proportion of Tartaric Acid and Potash.

But in taking Rhubarb as a Blood Purifier it is necessary to eat a large quantity to gain a necessary proportion of Potash and Tartaric Acid.

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Hence it is clear that "Frazer's Sulphur Tablets" are produced and act on the lines of Nature herself, as such are bound to be as purifying and curative as they are found to be in practice.

Furthermore, "Frazer's Sulphur Tablets" cause no shock, no hurt, and no interference with other functions; but rather benefit and tone by gentle action on the blood-vessels, almost every organ of the body. They are positively safe, both for women and children.

For the ailments of children "Frazer's Sulphur Tablets" are especially noteworthy, for they are pleasant alike to the eye and taste, and correct costiveness, allay feverishness, disperse inflammatory and eruptive matters, and purify the blood. For Eczema, Erysipelas, Nettle-Rash, Sores, Ulcers, and Eruptions, and for Rheumatism and Constipation, they will also be found of great service.

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If you have Rheumatism, Yes! They will kill the decomposed and poisonous excess of uric acid in the blood, causing the disease.

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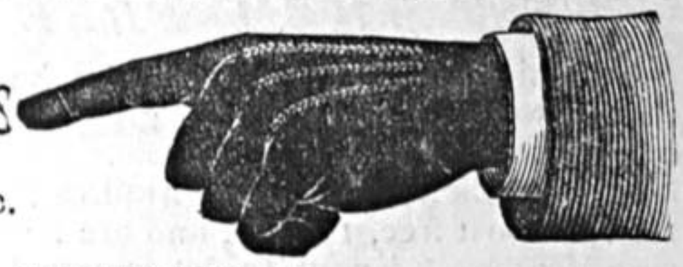

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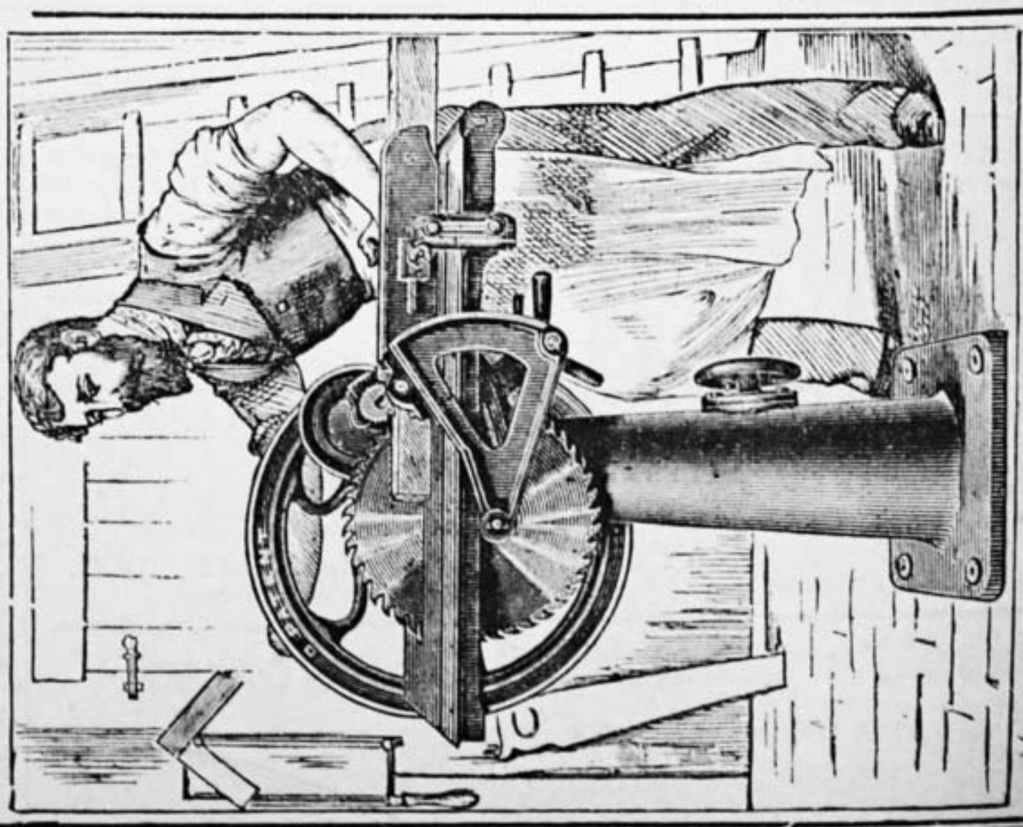

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